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A Magazine of Western Ornithology

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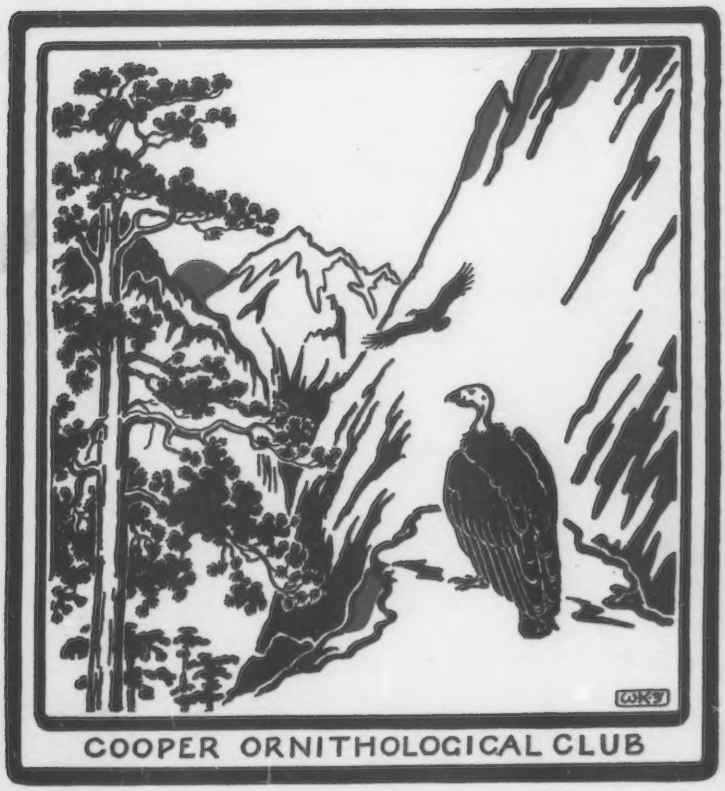

COOPER ORNITHOLOGICAL CLUB

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A Magazine of Western Ornithology

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THE CONDOR

VOLUME 44 NOVEMBER-DECEMBER, 1942 NUMBER 6

REGULATION OF SPRING MIGRATION IN JUNCOS

By ALBERT WOLFSON

Prior to 1925 information concerning the nature of the annual stimulus that induces bird migration was gained primarily from observations made under natural conditions and from banding. The limitations of these methods led to speculations none of which offered a satisfactory exposition of the mechanism involved. Within recent years experimental procedure has been utilized as a new approach to this problem, and the results of this work, when combined with those of the earlier studies, show promise of bringing us closer to a solution.

The impetus for the use of the experimental method in analyzing migration was provided by the results of a series of experiments performed by Rowan (1929). He found that if juncos were subjected to artificial increases in day length in the fall and winter their gonads would recrudesce. With this means of controlling the size of the gonads, Rowan conducted several experiments in migration. They were performed over a period of years and involved the releasing of birds with their gonads at various stages of development. From the results obtained he concluded that migration is controlled by the gonads and hence is a part of the breeding cycle. When the gonads are at winter minimum or spring maximum, there is no inclination to migrate. The stimulus for migration is present, however, when the gonads are recrudescing (spring) or regressing (fall) in response to changes in day length, because of the secretion of the interstitial cells which occur abundantly only during these phases. Later work with castrated crows led Rowan (1932) to conclude that the autumnal migration is independent of the influence of the gonads.

In addition he attempted to show how the increase in day length induces gonadial growth. He substituted compulsory exercise for the artificial light and concluded that light was important only in so far as it enabled the birds to exercise and that this daily increase in activity was the factor which induced gonadial recrudescence.

Since Rowan's initial work (1929) there has been experimentation in many laboratories on the relation of day length to breeding cycles in all the classes of vertebrates. The gonadial cycles have been successfully manipulated in many species, but no corroborative data have appeared for Rowan's "exercise theory." Instead, the theory that light itself is the real factor involved has been promulgated, and although it is accepted by most students of the subject, the evidence for it is confusing and contradictory, and the problem of how the increases in day length induce gonadial growth is still basically unsolved.

Similarly, no corroborative data have appeared for Rowan's theory of migration. The results of the only comparable studies (Wolfson, 1940) are not in agreement with his.

The present work was undertaken to aid in elucidation of these two basic problems —the determination of the annual external and internal stimuli which induce migratory behavior, and the mechanism whereby the external factors effect developmental changes

in the gonads. To accomplish this end, treated birds were released, and the results analyzed in terms of the functions of the gonads, the pituitary, and the hypothalamus. In addition, a careful survey was made of the evidence in support of each of the two theories concerning the mechanism whereby the increases in day length induce gonadial growth. In the light of this survey and our current knowledge of the functions of the hypothalamus and its relation to the pituitary, a new interpretation of the valid evidence can be offered (Wolfson, 1941) which embraces both theories.

In this paper the experiments in migration and the histological studies of the gonads are presented. Results of studies on the pituitary and of some related experiments will be described in later publications.

I wish to express my appreciation to Dr. Alden H. Miller for his material assistance, stimulating counsel, and encouragement during the execution of this work. I am also indebted to the staff of the Museum of Vertebrate Zoology and to the Department of Zoology of the University of California for making available the necessary equipment and laboratory facilities, and to Dr. L. W. Taylor for his coöperation in arranging facilities for captive birds. Much of the research was conducted while the author held the Abraham Rosenberg Research Fellowship in Zoology.

EXPERIMENTS IN MIGRATION

Two types of experiments were performed: induced migration and delayed migration. The species used for all experiments was the Oregon Junco (*Junco oreganus*), a type found commonly on the Pacific coast and in the interior of western North America. It was chosen for several reasons. First, and foremost, both resident and migratory races are contained in the species. Second, it is closely related to the species that Rowan employed and, therefore, the results can be compared with greater validity. Third, both migrants and residents occur in numbers in mixed flocks, are usually easy to trap, and thrive in captivity. Several Slate-colored Juncos (*Junco hyemalis*), which occur rarely in the flocks, also were used.

Miller's (1941) recent studies on speciation in the genus *Junco* provided detailed information on the taxonomy, distribution, and relationships of the members of the *oreganus* group. Without this information it would have been difficult to interpret accurately the results of the experiments.

The migratory races which occur at Berkeley, California, where the experiments were performed, are *J. o. thurberi*, *J. o. shufeldti*, *J. o. montanus*, and *J. o. oreganus*.

The breeding range of the members of *thurberi* which winter at Berkeley comprises the Transition and Boreal forests of the coastal districts and the Sierran-Cascade Mountain system in California, north and east of San Francisco Bay. *Shufeldti* breeds in the coastal regions of southern British Columbia, Washington, and Oregon, and intergrades directly with *thurberi*. Populations of *montanus* occur in eastern Oregon, eastern Washington, interior southern British Columbia, northern and eastern Montana, and northwestern Idaho. *Oreganus* is the most northern of the races breeding in the humid coast belt; it occurs in summer from Queen Charlotte Sound, British Columbia, to Yakutat Bay, Alaska.

The two races of *J. hyemalis* which were used are *J. h. hyemalis* and *J. h. cismontanus*. The breeding range of *J. h. hyemalis* extends from the arctic coast of Alaska to New England. The migrants which reach Berkeley probably come from western Canada or Alaska. *J. h. cismontanus* breeds in the interior of northern British Columbia.

Berkeley is at the northern limit of the range of the resident race, *J. o. pinosus*. This form extends southward from the San Francisco Bay region along the coast through Monterey and San Benito counties to San Luis Obispo County.

INDUCED MIGRATION

The purpose of these experiments was to induce a northward migration in winter, two months earlier than the normal time of migration at the end of March. The plan was to subject the experimental birds to artificially increased day lengths during December and January, release them, with the controls, when they were ready to migrate, and record the subsequent behavior by means of trapping and field observations.

Experiment 1.—The first experiment was performed in the winter of 1938-1939. The birds were trapped in October, November, and early December at the poultry ranch in Strawberry Canyon on the campus of the University of California. From here they were taken to the Museum of Vertebrate Zoology where they were banded, identified to race by comparing them with series of skins, and housed indoors for several days. Any individual which could not be identified beyond doubt as a resident or migrant was released. After the birds were accustomed to captivity, they were taken

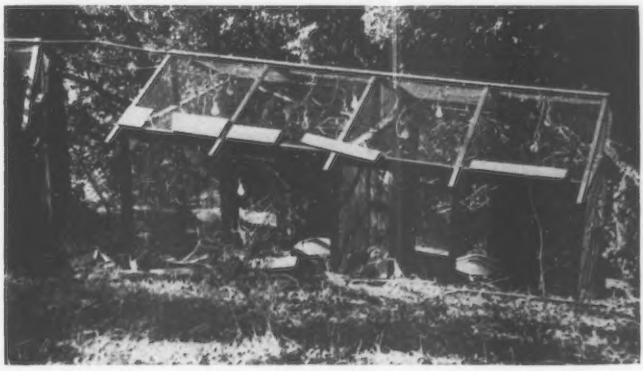

Fig. 79. Outdoor aviary used in experiments with the Oregon Junco in Strawberry Canyon, Berkeley.

to the experimental outdoor cages situated near the trapping stations. Two groups of cages, about five feet apart, were utilized. One group (fig. 79) comprises two adjacent cages, the other three, only two of which were used. The cages are approximately 8′ x 8′ x 8′ and each contains a four-walled house for shelter in inclement weather. The two experimental cages were equipped with two tiers of lights of four bulbs each. They were placed to illuminate all parts of the cage about equally and to prevent shadows and dark corners in which the birds might roost. Two cages in the group of three were used for the controls and were sufficiently blacked out to allow the birds to roost normally.

In spite of the large size of the cages only 16 to 20 juncos were placed in each in order to prevent crowding and to allow sufficient flying space. It was imperative that the birds be in good health. The basic diet was unmixed Argentine canary seed which was kept in sheltered, automatic feeders of one gallon capacity and was renewed when needed to insure an adequate supply. Occasionally humus and freshly cut grass were strewn on the floors of the cages. The juncos also received some insect food, for the cages were situated in a live oak-California bay habitat. On many occasions juncos were seen capturing moths and other flying insects which were attracted to the lights at

night. There was always a supply of water for drinking and bathing. Indicative of the successful handling of the birds was a low mortality.

On December 12, 1938, the day length was increased one hour, one-half hour each at sunset and sunrise. The normal day length at Berkeley on this date is approximately 9 hours and 40 minutes, only 5 minutes longer than the shortest day of the year. Thereafter the day length was increased automatically about 3 minutes a day, the increments being added partly in the morning and partly in the evening. On February 7, 1939, when the juncos were released, the day length for the experimentals was 13 hours and 30 minutes, for the controls 10 hours and 30 minutes.

Samples were taken during the experiment to determine when the experimentals had reached an internal state similar to that which occurs at the normal time of migration. The gonads were fixed in Bouin's fluid and measured after fixation with dial calipers calibrated to tenths of a millimeter. The anteroposterior and the transverse dimensions of the testes were taken as they lay on the dorsal body wall. The fat condition of each bird, an important indicator of a bird's readiness to migrate, was estimated and recorded in four classes: no fat, little fat, medium fat, and heavy fat. Occasionally plus and minus were used to indicate extremes. These classes denote not only the amount of fat present, but also its distribution. In a bird with "no fat" the furculum and pterylae are practically clean. In a bird with "little fat" there are small amounts on these parts. In the "medium" class, fat occurs in good amounts along the pterylae, fills the crotch of the furculum and begins to appear in the axilla, on the flanks, sides of the neck, lower back, and abdomen. In a bird with "heavy fat" the amounts are increased in all of the aforementioned locations, especially the abdomen and lower back. The abdomen bulges with fat due to the intraperitoneal deposition, in addition to the subcutaneous, and the yellow color is readily visible through the skin. These classes are similar to those which Blanchard (1941) has used in describing the fat condition of the White-crowned Sparrow (*Zonotrichia leucophrys*). However, there is a difference in terminology in two classes; our "heavy" and "heavy +" classes are equivalent to her "fat" and "very fat" categories, respectively.

A summary of the samples taken prior to the date of release is given in table 1. The

TABLE 1

Samples taken in 1939 before release of February 7

Date	Sample no.	Band	Sex	Race*	Testis size mm.	Testis volume, mm.³	Body weight, gm.	Fat
Experimentals								
Jan. 4	2	139-5738	♂	T	L-1.1x1.0	.57	.....	None
					R-1.1x1.0	.57	.....	
Jan. 16	27	38-17464	♀	T			16.0	Medium
Jan. 26	7	139-5771	♂	S	L-1.4x1.1	.88	15.5	None
					R-1.2x1.2	.90		
Feb. 5	5	139-5763	♂	T	L-2.2x1.6	2.56	19.0	Heavy+
					R-1.9x1.7	2.88		
Controls								
Jan. 4	3	139-5714	♂	T	L-1.0x0.7	.25	.....	None
					R-0.9x0.8	.30		
Feb. 5	15	139-5707	♂	S	L-1.2x0.9	.51	17.0	Little
					R-1.2x0.8	.40		
Feb. 5	37	.....	♂	S	L-.....		14.7	None
					R-0.9x0.8	.30		

* Subspecies are abbreviated in tables as follows. Migrants: T=*thurberi*; S=*shufeldti*; M=*montanus*; O=*oreganus*; C=*cismontanus*; H=*hyemalis*. Resident: P=*pinosus*.

controls had normal gonads for February 5, while the gonads of the experimentals were well advanced and equivalent to those of birds taken in late March when migration normally occurs. The "heavy fat" condition of the experimentals, in addition to the enlarged testes, is diagnostic of a readiness to migrate. At the normal time of migration the testes range in total volume (left plus right) from 2.0 mm.^{3} to 4.5 mm.^{3}, and the birds have a heavy or medium deposition of fat.

Prior to release the birds were banded with combinations of colored bands for the identification of individuals, and small curved chicken feathers, which were dyed various colors to indicate residents and migrants, experimentals and controls, were attached to the bases of the middle rectrices with Duco cement. With the aid of these colored feathers the behavior of the resident and migratory races after release could be recorded and the birds could be easily found in the field. The feathers did not interfere with the flight of the bird, nor did they prevent the spreading of the tail. The birds were well accustomed to them within a few hours and I did not observe any changes in behavior attributable to them.

On February 7, 26 experimentals and 19 controls were released. The numbers of each sex and subspecies are given in table 2. One of the experimental migrants, a male *oreganus*, had been used in an earlier experiment in 1938 and had returned to the trapping station after the breeding season. It was familiar, therefore, with the immediate vicinity and had exhibited a strong "homing instinct."

The doors of the cages were opened at 2:55 p.m. and within a period of 5 minutes most of the birds were in the California bay tree adjacent to the cages. I chased out the remainder of the birds. Several minutes later I observed the majority of the group feeding in the live oaks about 25 yards west of the cages. They appeared to be in a

TABLE 2

Birds released and retrapped in Experiment 1

	Experimentals				Controls			
	♂		♀		♂		♀	
	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Ret.	Ret.
Migrants								
thurberi	5	3	1	1	4	4	5	5
shufeldti	1	1	8	5	1	1	1	1
montanus	....	....	1	1	....	....	1	1
oreganus	2	0	1	0	2	1	2	2
Totals	8	4	11	7	7	6	9	9
Per cent retaken		50		64		86		100
Residents								
pinosus	2	2	5	4	1	1	2	2
Per cent retaken		100		80		100		100

loose flock. Until 3:10 p.m. it had been raining lightly. The sky was overcast and a strong wind was blowing from the northwest. Then the rain abated, and it became brighter on the ground. A *pinosus* was singing while the flock was in the oak trees. When it became brighter, the birds dropped to the ground to continue their feeding. The flock became more compact and seemed identical to other winter flocks in form and behavior. There was no fighting, chasing, or evidence of breeding behavior. Migrants and residents, experimentals and controls were together, and they foraged as close to each other as individuals in a normal flock. The singing of the *pinosus* became more regular during this period of feeding on the ground. Six full songs were given in 10 minutes. Wild *pinosus* were not yet singing regularly at Berkeley. I approached closer to the birds and flushed them. They flew as a flock, 2 to 3 birds starting first and the

rest following, to a point about 50 yards eastward where they began feeding again. I repeated this procedure several times to confirm the flocking behavior.

At 4:00 p.m. it began to rain again and the wind became stronger. I left the large flock about 200 yards east of the cages and found a near-by group of 6 juncos by following the song of the *pinosus*. I returned to the cages and near-by trapping stations where seed had been placed and observed 2 birds, both of them in the cages. The doors of the cages had been left open and food and water were available. About 4:30 p.m., the large flock appeared at the trapping station 30 yards north of the cages. It was still raining and the attached chicken feathers had contracted to thin lines. At 5:00 p.m. when I left the canyon, these birds were still feeding.

The significant points in these observations follow: (1) In spite of the fact that the birds were in different physiological states, within 15 minutes after they were free they were in a compact flock. (2) During the first two hours of their freedom the birds moved in an approximate circle within an average radius of 100 yards from the cages. (3) They remembered and returned to the trapping stations where many of them had been caught two to three months earlier. (4) The singing of the *pinosus* (and courtship behavior observed later) was definitely in advance of the season and indicated a difference between the migrants and residents in the response to the experimental treatment.

During the next few days trips were made regularly to the canyon. The juncos were observed at the trapping stations and around the cages. They were in well formed flocks which included wild juncos. Exceptions were two *pinosus*, a male and female, which were paired. They kept together, were not seen in any flock, and exhibited weak courtship behavior. Individuals were recorded by means of the colored band combinations and trapping. Any trapped juncos were released immediately. The plan was to allow several days for the birds to become accustomed to their freedom before they were retrapped and sampled. On February 12, five days after the release, the first samples were taken. The next large group was taken on February 15, after which date trapping became irregular. These samples are listed in table 3.

TABLE 3.

Samples taken in 1939 after release of February 7

Date	Sample no.	Band	Sex	Race	Experimentals: Testis size mm.	Testis volume, mm.³	Body weight, gm.	Fat
Feb. 12	4	139-5760	♀	P			16.0	None
Feb. 12	8	139-5751	♀	P			15.5	None
Feb. 12	9	139-5774	♂	S	L-1.4x1.1	.88	17.5	Little
					R-1.4x1.1	.88		
Feb. 15	41	139-5791	♂	P	L-8.1x6.2	163.1	18.2	None
					R-6.9x6.3	143.4		
Feb. 15	46	139-5773	♂	T	L-1.7x1.2	1.29	17.5	Medium—
					R-1.5x1.2	1.13		
Feb. 15	47	139-5796	♂	P	L-6.4x4.5	67.9	16.7	None
					R-5.7x5.0	74.5		
Feb. 15	48	139-5740	♀	T			16.8	Medium
Feb. 15	49	139-5749	♀	S			17.4	Medium+
Feb. 15	50	139-5789	♀	P			14.5	None
Feb. 15	52	139-5770	♀	S			16.2	Little
Feb. 15	54	139-5745	♀	M			19.7	Heavy
Mar. 16	62	139-5793	♀	S			17.2	Medium
Mar. 16	64	139-5756	♂	T	L-1.4x1.1	.88	17.2	Medium
					R.....			
Mar. 20	79	139-5746	♀	P			15.1	None
Mar. 23	86	139-5733	♂	T	L-1.7x1.3	1.51	18.5	Heavy+
					R-1.6x1.4	1.64		

Controls

Date	Sample no.	Band	Sex	Race	Testis size mm.	Testis volume, mm.³	Body weight, gm.	Fat
Feb. 12	13	138-5757	♂	O	L-1.1x1.8	.37	20.8	Medium+
					R-0.9x0.8	.30		
Feb. 12	16	139-5797	♂	T	L-0.7x0.6	.13	17.3	Medium
					R-0.6x0.6	.13		
Feb. 12	17	139-5788	♀	P			16.6	None
Feb. 12	26	139-5711	♀	T			19.5	Medium+
Feb. 12	36	139-5723	♂	S	L-0.9x0.6	.16	17.3	Medium
					R-0.9x0.7	.23		
Feb. 15	38	139-5715	♂	P	L-1.8x1.5	2.12	16.6	
					R-1.7x1.5	2.00		Medium
Feb. 15	40	139-5702	♂	T	L-1.0x0.7	.25	17.2	
					R-0.9x0.8	.30		Medium
Feb. 15	42	139-5701	♂	T	L-1.0x0.7	.25	17.1	
					R-1.0x0.8	.33		Little
Feb. 15	45	139-5705	♂	T	L-1.0x0.8	.33	16.5	
					R-0.9x0.7	.23		None
Feb. 15	51	38-31507	♀	S			16.5	Medium
Feb. 15	53	139-5716	♀	T			16.2	Medium

The purpose of sampling the retrapped birds was to determine their readiness for migration by recording the condition of the gonads, the fat, and the general health. A study of table 3 reveals that the experimental juncos that were retrapped in February were not ready to migrate, even though the gonads were enlarged, because of an inadequate amount of stored fat. One possible exception is sample number 54, a female *montanus*. Apparently the day length schedule was not correct for a uniform response among the migrants. A *thurberi* that was sampled before the release was definitely ready to migrate, and some of the experimental migrants must have responded equivalently, for not all of them were retrapped.

The numbers and kinds of juncos which remained are recorded in table 2. In a few instances the records are from field observations and not from trapping, but these are included in the table as retraps when it is definitely known that the birds failed to migrate. A complete history of the birds that were retrapped soon after release and those that repeated frequently in subsequent winters is on file at the Museum of Vertebrate Zoology. It is noteworthy that the males responded to the light treatment better than the females. The probability that they undertook a northward migration will be discussed later. The almost complete retrapping of the controls and residents emphasizes the significance of the failure to retrap all of the experimental migrants.

The apparent deficiencies in this experiment were an insufficient number of males, particularly of the more northern races, and an inadequate day length schedule, due to the too small daily increases and an insufficient total day length at the end of the experiment. To rectify these deficiencies and obtain more conclusive evidence the experiment was repeated in the winter of 1939-1940.

Experiment 2.—The main differences in method in this experiment were the day length schedule and the increased number of birds that was released.

The experiment was begun on December 10 when the normal day length was 9 hours and 40 minutes. On that day the day length was increased one hour and 30 minutes, making a total day length of 11 hours and 10 minutes. Thereafter, the day length was increased about 10 minutes every two days, equal increments being added before sunrise and after sunset. On the day of release, January 31, the experimental day length was 15 hours and 30 minutes, the normal day length, 10 hours and 15 minutes. Dis-

counting the initial increase, the average daily increase was about 5 minutes for the 51 days, as compared with a daily increase of about 3 minutes for the 57 days in experiment 1. In experiment 1, the daily increases were controlled automatically by an astronomical dial on a time clock; the clock was set at the start only. In this experiment and the one following, the daily lighting was still controlled by the time clock, but the clock had to be set every two days for the desired increment.

To provide for an increased number of experimentals, the control cage nearest to the experimental group was equipped with lights. The remaining control cage was well protected from the artificial light, but it could not be blacked out completely.

The samples taken prior to release are listed in table 4. The lighting schedule was far more effective than before, since the gonads responded more uniformly and were larger than gonads at the normal time of migration. The difference in response between the residents and migrants is clearly indicated by the gonad sizes and fat condition. Samples 162, 163, 179, and 180 show low weights because of intestinal parasites and internal injuries.

On January 31, 53 experimentals and 23 controls were released. Three residents and three migrants had repeated at the trapping stations before they were retained for this experiment, and were, therefore, familiar with the grounds of the poultry ranch. The number of each sex and subspecies is given in table 5. To insure the correct date for release, the fat condition of each bird was examined when it was "feathered" and "color-banded" by blowing on the feathers and exposing the apteria. The amount and distribution of the yellow fat was easily estimated. Of the 43 experimental migrants that were released only 7 did not show a "heavy fat" deposition. The controls showed "no fat" or "little fat."

TABLE 4

Samples taken in 1940 before release of January 31

Date	Sample no.	Band	Sex	Race	Testis size mm.	Testis volume, mm.³	Body weight, gm.	Fat
Experimentals								
Jan. 12	153	39-61131	♂	O	L-2.0x1.5	2.36	19.7	Heavy—
					R-1.9x1.5	2.24		
Jan. 14	154a	39-61060	♀	P			.....	None
Jan. 18	162	39-61107	♂	S	L-1.8x1.2	1.36	13.3	None
					R-1.6x1.2	1.21		
Jan. 23	163	39-61071	♂	T	L-1.8x1.1	1.14	13.4	None
					R-1.5x1.2	1.13		
Jan. 26	164	39-61062	♂	P	L-6.4x4.8	77.4	18.5	Medium—
					R-5.5x5.3	80.9		
Jan. 26	165	39-61118	♂	P	L-3.1x2.4	9.38	15.6	Little
					R-2.8x2.3	7.76		
Jan. 26	166	.....	♂	P	L-2.0x1.6	2.68	16.9	None
					R-2.0x1.6	2.68		
Jan. 26	167	39-61059	♀	S			16.6	Little
Jan. 27	168	39-61125	♂	S	L-2.6x2.1	6.00	22.6	Heavy+
					R-2.5x2.1	5.77		
Jan. 27	169	39-61103	♀	T			19.0	Heavy
Jan. 27	177	39-61136	♂	P	L-5.3x4.5	56.2	17.9	Little
					R-4.3x4.1	38.0		
Controls								
Jan. 30	178	39-61146	♂	P	L-1.3x0.9	.55	14.8	None
					R-1.1x1.1	.63		
Jan. 30	179	39-61139	♀	S			11.7	None
Jan. 30	180	39-61152	♀	T			12.6	None

The doors of the cages were open at 10:00 a.m. After waiting ten minutes and not seeing any juncos fly out, I drove all of them from the cages in about three minutes. They flew into the bay and live oak trees over the cages. For a few minutes there was no foraging or singing. The birds were perched quietly, and there were several attempts at preening. Then there was an occasional song and some controls and residents came to the ground to feed. Although the sky was overcast, it was bright. After a half an hour I noticed that there were only a few controls and residents about the cages, but no experimental migrants. I left the vicinity of the cages and started north to the trapping stations. Two hundred yards west of a trapping station was a large, loose flock of experimentals feeding in the moist grass. The yellow marker feathers stood out well. Not one control bird was in this flock of 40 experimental migrants and residents.

During the next hour the flock continued foraging in this location. There were at least two instances of sexual chasing, involving both the residents and migrants. Song was given occasionally. I left the canyon at 12:30 p.m. and returned at 2:30 p.m. I found the controls and some experimentals around the cages and identified experimental migrants and experimental residents singing. Activity became more pronounced that afternoon, with abundant singing and definite and frequent chasing. Two experimental residents seemed to be paired. They followed each other, and there was singing and chasing. I left the vicinity of the cages and found the large flock again at the same

TABLE 5

Birds released and retrapped in Experiment 2

	Experimentals				Controls			
	♂		♀		♂		♀	
	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Ret.	Ret.
Migrants								
thurberi	9	1	7	5	5	5	8	7
shufeldti	12	1	6	2	2	2	2	2
montanus	1	0	2	0	....	....	....	....
oreganus	5	0	....	....	2	1	....	....
cismontanus	....	....	1	0	....	....	....	....
Totals	27	2	16	7	9	8	10	9
Per cent retaken		7		44		89		90
Residents								
pinosus	7	5	3	1	4	4	....	....
Per cent retaken		71		33		100		

place. The flock, which now included 2 controls, moved northward gradually about 300 yards, foraging on the ground occasionally for short periods. It then moved south again over the same ground it had just covered. When I left the canyon at 4:30 p.m., the flock was foraging where it was first discovered.

On February 1, I returned to the canyon at 8:00 a.m. Singing was common in the experimental migrants and residents, whereas no control was ever heard singing. The experimentals were less numerous and the large flock of the day before could not be found. The controls and experimentals that were observed were in the vicinity of the cages. On February 2 the traps were set and 13 birds were caught and sampled. On February 3 several controls and residents were seen in the vicinity of the cages. Traps were set again on February 4 and two experimentals were caught and sampled. The two experimental *pinosus* seen earlier were still paired. The male was sampled on February 5 and had testes of breeding size. From this date on regular visits were made to the canyon and the individuals found were recorded. No further samples were taken until March when two experimentals were discovered and trapped.

The significant points in these observations are the flocking behavior, the restriction of foraging to an area near the cages and the trapping stations, and the difference in behavior of experimental residents and migrants as exemplified by pairing. These points are in agreement with the behavior in experiment 1.

The samples taken after the release are listed in table 6. Several points are worth noting. (1) Only two experimental migrant males were retaken. (2) The study of the fat condition of the experimental migrants prior to release showed that 7 birds did not have a heavy deposition of fat. All of these birds were retrapped, and are included in the table; one bird, number 204, had reached the "heavy fat" class, although it was released only four days before with little fat. Its gonads were also much advanced over the other migrant samples. This storage of abundant fat in four days indicates that a definite physiological change is produced by the experimental treatment which persists even after the treatment lapses. This bird may not have been able to get a sufficient amount of proper food in captivity because of the definite social hierarchies which are formed in the cages. (3) Only one retrap, number 205, was definitely ready to migrate but did not. Might its failure to migrate be due to the fact that it was not part of a

TABLE 6

Samples taken in 1940 after release of January 31

Date	Sample no.	Band	Sex	Race	Testis size mm.	Testis volume, mm.^{3}	Body weight, gm.	Fat
Experimentals								
Feb. 2	181	39-61115	♀	T			16.5	Little
Feb. 2	183	39-61110	♀	S			17.4	Medium
Feb. 2	184	39-61075	♂	P	L-7.0x5.7	118.8	15.9	None
					R-6.9x6.0	130.0		
Feb. 2	185	39-61082	♀	T			14.9	Little—
Feb. 2	190	39-61038	♂	P	L-7.8x5.2	110.5	16.1	None
					R-6.6x6.1	128.7		
Feb. 2	191	39-61083	♀	T			16.2	None
Feb. 2	193	39-61057	♂	S	L-2.4x1.9	4.54	17.6	Little
					R-2.3x2.1	5.32		
Feb. 4	204	39-61065	♂	T	L-4.3x3.5	27.6		Heavy
					R-3.9x3.3	22.2		
Feb. 4	205	39-61073	♀	S			20.0	Heavy
Feb. 5	206	39-61066	♂	P	L-7.3x5.5	115.5	17.2	None
					R-6.1x6.1	118.8		
Mar. 16	212	39-61081	♀	T			17.7	None
Mar. 30	222	39-61050	♀	T			18.4	Little
Controls								
Feb. 2	182	39-61145	♀	T			16.6	Little
Feb. 2	188	39-61124	♀	T			16.5	Little+
Feb. 2	189	39-61142	♂	T	L-1.2x0.9	.51	17.1	Little
					R-1.2x0.8	.40		
Feb. 2	192	39-61138	♂	P	L-1.3x0.9	.55	16.3	None
					R-1.1x0.9			
Feb. 2	194	39-61156	♂	T	L-1.0x0.8	.33	17.9	Medium
					R-1.1x0.8	.37		
Feb. 2	195	39-61132	♂	T	L-0.9x0.7	.23	16.1	Little—
					R-0.9x0.7	.23		

migrating flock? (4) The fully developed gonads of the *pinosus* stand in marked contrast to the rescrudescing gonads of the migrants. Yet the experimental treatment of migrants and residents was identical.

The numbers of each sex and subspecies that were retaken are listed in table 5. The small number of experimental migrants that was retaken, particularly of males, as

compared to the almost complete retrapping of the controls and residents strongly indicates that the experimentals migrated. Positive proof of the fact that they did migrate, and northward too, was the retaking of an experimental migrant, a female *shufeldti,* at Redding, California, about 200 miles north of Berkeley, on February 10. Judging from the date of capture, the stormy weather which prevailed during the first week in February, and the disappearance of the experimental migrants from Strawberry Canyon after the day of release, I assume that the migrating flock left Berkeley either in the course of the night of January 31, or early on the morning of February 1.

The attached yellow feather was responsible for the record from Redding. The junco was caught by a cat, whose owner was attracted to the unusual appearance of the bird. He discovered the bands and forwarded them to the California Fish and Game Division in San Francisco. They informed the Biological Survey in Washington, and within a few days I was notified of the record. The flight of this bird was along the normal flight line of many migrants, namely through the Sacramento Valley. The lack of interference of the attached feather and bands with the flight of the birds is in some measure confirmed by this record.

As in experiment 1, the males showed the best response. The failure to retrap all of the experimental residents may be explained by the scattering of individuals caused by the activity of the mature gonads. Evidences of mating behavior among the *pinosus,* which were recorded in both experiments, lend support to this view.

In spite of the evidence obtained in this experiment, which proved that juncos could be induced to migrate northward during the winter by subjecting them to increasing day lengths, the experiment was repeated again during the winter of 1940-1941 to obtain additional evidence and to test the conclusions of the previous experiments.

Experiment 3.—One major innovation in method, a more advanced day length schedule, was adopted in an attempt to bring the birds into the migratory state earlier in January.

The experiment was begun on December 10, 1941, and the initial increase in day length was one hour and 35 minutes, making a total day length of 11 hours and 15 minutes. Thereafter until January 15, the day length was increased about 14 minutes every two days, and it was administered as before. From January 15 to January 29, when the juncos were released, the day length was constant at 15 hours and 20 minutes. The average daily increase until January 15 was about 7 minutes. A summary of the lighting schedules for the three experiments is given in table 7. All day lengths are approximated to within two minutes.

TABLE 7

Lighting schedules of induced migration experiments

	Experiment 1 1938-1939	Experiment 2 1939-1940	Experiment 3 1940-1941
Date of Start	December 12, 1938	December 10, 1939	December 10, 1940
Normal day length[1]	9 hrs. 40 min.	9 hrs. 40 min.	9 hrs. 40 min.
Initial increase	1 hr.	1 hr. 30 min.	1 hr. 35 min.
Total day length	10 hrs. 40 min.	11 hrs. 10 min.	11 hrs. 15 min.
Duration of Experiment	57 days	51 days	49 days
Average daily increase[2]	3 min.	5 min.	7 min.[3]
Date of Release	February 7, 1939	January 31, 1940	January 29, 1941
Experimental day length[4]	13 hrs. 30 min.	15 hrs. 30 min.	15 hrs. 20 min.
Normal day length	10 hrs. 30 min.	10 hrs. 15 min.	10 hrs. 10 min.

[1] Normal day length for December 21 is 9 hours and 35 minutes.
[2] Average daily increase from December 21 to April 1 (when migration has begun) is 2 minutes for the 100 days.
[3] Daily increases were administered for 36 consecutive days only.
[4] Day length for April 1 is 12 hours and 35 minutes.

The samples taken before release are given in table 8. The lighting schedule was more effective than in the previous experiments as shown by the gonads and fat condition of the *oreganus* that was sampled on January 11. The difference in gonadial response between residents and migrants is again confirmed by the uniform response of the *pinosus*.

Although many of the birds were ready to migrate by the middle of January, they were held until January 29 to insure a sufficient deposition of fat by the females. On that day 53 experimentals and 10 controls were released. The examination of the fat condition prior to release revealed that the controls and residents had "no fat," and all but 5 of the experimental migrants had a heavy deposition of fat. Three experimentals and one control had previous trapping histories.

The behavior on the day of release was similar to that in the previous experiment with two exceptions: there was more singing, and the flock which formed contained more controls. Because it was felt that the birds were retrapped too soon after the

TABLE 8

Samples taken in 1941 before release of January 29

Date	Sample no.	Band	Sex	Race	Testis size mm.	Testis volume, $mm.^3$	Body weight, gm.	Fat
Experimentals								
Jan. 3	268	140-65129	♀	O			17.9	Medium+
Jan. 4	276	140-65184	♂	T	L-1.7x1.6	2.28	.....	Medium—
					R-1.8x1.5	2.12		
Jan. 11	304	140-65121	♂	O	L-1.8x1.4	1.85	20.9	Heavy+
					R-1.7x1.5	2.00		
Jan. 18	307	140-65179	♂	P	L-3.7x2.9	16.3	16.0	None
					R-3.0x2.7	11.5		
Jan. 18	308	140-65187	♂	P	L-3.9x2.9	17.3	15.4	None
					R-3.5x2.6	12.4		
Jan. 18	309	140-65178	♂	P	L-3.3x2.6	11.7	14.6	Little
					R-2.9x2.6	10.3		
Jan. 18	310	140-65174	♂	P	L-5.1x3.6	35.8	15.8	Little
					R-4.6x4.0	38.5		
Jan. 21	320	140-65185	♀	S			19.0	Heavy+
Jan. 21	321	140-65150	♂	O	L-2.0x1.5	2.68	19.1	Heavy+
					R-1.8x1.7	2.72		
Jan. 23	322	140-65135	♂	P	L-6.3x4.9	79.4	.....	None
					R-5.9x5.1	80.5		
Jan. 29	325	140-65168	♀	P			15.7	None
Control								
Jan. 14	305	.....	♂	S	L-0.9x0.8	.30	15.6	None
					R-0.8x0.8	.27		

release in 1940, no birds were retrapped and sampled until February 13. Until then, however, trips were made to the canyon regularly and a record kept of all observations. Nearly all of the experimental migrants left before January 30, for from that date on no more than three were recorded. The controls and residents were seen regularly. The samples taken after release (see table 10) showed that the migrants which remained had an inadequate fat supply, and their gonads had not responded well. These migrants had only a little fat prior to release. A bird that was released with little fat showed a heavy fat supply when it was retrapped on February 14. It was released and not retrapped again.

That the lighting schedule employed in this experiment was the most effective of any used is shown by table 8. The results substantiate beyond any reasonable doubt the

TABLE 9

Birds released and retrapped in Experiment 3

	Experimentals ♂		Experimentals ♀		Controls ♂		Controls ♀	
	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.
Migrants								
thurberi	12	1	1	0	3	3	....	....
shufeldti	3	0	7	0	2	2	2	2
montanus	1	0	2	0	....	....	....	....
oreganus	10	1	2	0	....	....	....	....
Totals	26	2	12	0	5	5	2	2
Per cent retaken		8		0		100		100
Residents								
pinosus	10	5	5	1	2	2	1	1
Per cent retaken		50		20		100		100

TABLE 10

Samples taken in 1941 after release of January 29

Date	Sample no.	Band	Sex	Race	Testis size mm.	Testis volume, $mm.^3$	Body weight, gm.	Fat
Experimentals								
Feb. 13	338	140-65122	♂	T	L-1.6x1.2	1.21	15.7	None
					R-1.5x1.3	1.33		
Feb. 13	342	140-65163	♂	P	L-3.3x2.3	9.14	16.5	None
					R-3.1x2.3	8.58		
Feb. 13	343	140-65123	♀	P			14.5	None
Feb. 14	350	140-65126	♂	P	L-7.9x5.3	116.1	15.6	None
					R-7.2x5.7	112.6		
Feb. 14	351	140-65171	♂	P	L-6.5x4.5	69.0	16.5	None
					R-5.3x5.0	69.2		
Feb. 14	353	140-65136	♂	P	L-1.9x1.4	1.95	16.3	None
					R-1.7x1.3	1.51		
Mar. 16	B-2	140-65159	♂	O	L-1.2x0.8	.40	17.6	Little
					R-1.0x1.0	.58		
Controls								
Feb. 13	337	39-61192	♂	S	L-1.1x0.7	.28	16.3	None
					R-1.0x0.7	.26		
Feb. 13	339	38-17436	♂	T	L-1.8x1.3	1.59	18.1	None
					R-1.6x1.3	1.42		
Feb. 13	340	39-61188	♂	T	L-1.2x0.8	.40	16.4	None
					R-0.9x0.8	.30		
Feb. 13	341	39-61193	♂	S	L-1.2x0.8	.40	17.5	Little
					R-1.2x0.9	.51		
Feb. 13	345	39-61189	♀	S			15.8	None
Feb. 14	352	39-61191	♂	P	L-1.9x1.4	1.95	15.5	Little
					R-1.7x1.4	1.74		
Feb. 14	354	140-65177	♀	S			15.1	Little

conclusions and results of the previous experiments. Of the 38 experimental migrants that were released only 2, about 5 per cent, failed to migrate, as compared with 58 per cent in experiment 1, and 20 per cent in experiment 2. The scattering of the experimental *pinosus* was again demonstrated. The controls were retrapped completely despite the small number that was used and their freedom for two weeks. Their extended freedom and recapture lends support to the belief that if the migrants had failed to go north, they would not be several miles away, but they would be in Strawberry Canyon and in the vicinity of the cages.

From the results of these three experiments, I conclude that juncos can be induced to migrate northward during the winter by subjecting them to artificially increased day lengths which will bring them into a physiological state similar to that which prevails at the normal time of migration.

DELAYED MIGRATION

These experiments were undertaken to determine whether juncos would migrate if detained on their wintering grounds and released when their gonads had attained breeding size.

The results of two of these experiments (numbers 4 and 5) have already been reported (Wolfson, 1940). They demonstrated that juncos will migrate as late as sixty days after the normal date of departure even though their gonads are of breeding size. For further corroboration, the experiment was repeated in 1940.

Experiment 6.—Juncos were trapped from December, 1939, through March, 1940, and handled as in the previous experiments in regard to housing, banding, and examination of fat prior to release. No artificial lighting was employed. On June 8, 1940, 26 migrants, 3 of which had previous trapping histories, and 8 residents were released. Only three birds did not show a heavy deposition of fat. The aggressive behavior of the birds after release simulated that in experiment 4, but it was not as lasting. By early afternoon the singing, chasing, and scolding, which were prevalent after the release at 10:00 a.m., had practically ceased.

On June 9 only one migrant and two residents could be found, and they were in the vicinity of the cages. On June 10 these birds were collected (see table 12). The migrant showed only a medium supply of fat, whereas prior to release its fat condition was recorded as "little." The ovaries of all three birds contained well developed follicles and the oviducts were enlarged. During the summer only one marked bird, a male *pinosus* was seen in the canyon, but in the fall and winter three migrants were retrapped. A summary of the numbers of the birds that were released and retrapped in the delayed migration experiments is given in table 11. The results of this experiment further substantiate the previous conclusion.

TABLE 11

Birds released and retrapped in delayed migration experiments

	Experiment 4—1938				Experiment 5—1939				Experiment 6—1940			
	♂		♀		♂		♀		♂		♀	
	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.
Migrants												
thurberi	4	0	2	0	7	0	8	0	7	0	7	1
shufeldti	9*	0	3	0	5	1	....	....	2	0	2	0
montanus	1	0	1	0	....	....	1	0	....	....	1	0
oreganus	5	0	7	0	4	0	2	0	4	0	2	0
cismontanus	1	0	....	....	....	....	....	....	....	....	....	....
hyemalis	....	....	1	0	....	....	....	....	1	0	....	....
Totals	20	0	14	0	16	1	11	0	14	0	12	1
Per cent retaken		0		0		6		0		0		8
Residents												
pinosus	2	2	3	2	5	2	1	1	4	1	4	2
Per cent retaken		100		67		40		100		25		50

* Sex identification of three of these is questionable.

TABLE 12

Samples taken in Experiment 6—release of June 8, 1940

Date	Sample no.	Band	Sex	Race	Testis size, mm.	Testis volume, mm.^{3}	Body weight, gm.	Fat
Birds not released								
Jun. 4	226	39-61141	♂	T	L-6.0x4.5	63.5	.....	Medium
					R-5.1x4.1	44.7		
Jun. 5	227	39-61178	♀	T			.....	Heavy
Jun. 5	228	38-31507	♀	S			.....	Heavy
Jun. 5	229	39-61045	♀	S			.....	Heavy
Birds released								
Jun. 10	230	39-61171	♀	T			.....	Medium
Jun. 10	231	39-61165	♀	P			.....	Little
Jun. 10	232	39-61155	♀	P			.....	Medium—

HISTOLOGY OF THE GONADS

Oregon Juncos were trapped in the field, or taken from the experimental cages, and were brought into the laboratory alive. They were killed with chloroform or ether, weighed, skinned, and the gonads fixed in Bouin's fluid within ten minutes after death. Both testes were measured after fixation with dial calipers calibrated to tenths of a millimeter. The anteroposterior and the transverse dimensions of the testes were taken as they lay on the dorsal body wall. Dioxane was used for dehydration and paraffin for embedding. Serial sections of the testes were cut sagittally at ten microns, but only the center sections of the larger testes were studied. Previous studies of several complete series had shown that no differences existed at various levels. The sections were stained with Delafield's haematoxylin and eosin. For accuracy in making comparisons of size, the volumes of the left and right testes were computed, and then added to give the total testis volume. The formula for the volume of an ellipsoid $V=4/3\ \pi ab^2$ was used, where a=½ the longest diameter and b=the shortest diameter. From these volumes the most probable growth curve was calculated. The distribution of points fitted best a simple exponential curve of the general formula $V=A\times 10^{Bt}$ where V=volume, t=time, and A and B are constants to be determined from the data. From this formula the most probable volume of a testis collected on a particular date after November 30 could be determined.

As other workers have found, the left testis is longer when there is a difference in length between left and right testes, but upon computing the volumes it was found that in many instances the right testis is larger. This is due to its more nearly spherical shape in contrast to the more ellipsoidal shape of the left testis. Studies of both testes of several individuals showed that there was little or no histologic difference between them, except when the difference in volume was great.

GONADS OF RESIDENT MALES

Gross changes.—The testes reach their minimum size, 0.5 mm.^{3}, in late October, and remain at this size through November and early December. Beginning in the middle of December there is a slight, gradual increase in size with the testes reaching a volume of 1.1 mm.^{3} by the middle of January. From this time until the end of March and early April when the testes reach their maximum size of 200 mm.^{3} there is a rapid increase in the rate of growth. These changes are indicated in the graphs (figures 80 and 81).

Volume changes and growth rates of equivalent magnitude have been described

for other passerine birds (Loisel, 1900, 1901; Kirschbaum and Ringoen, 1936, for *Passer domesticus;* Watson, 1919, *Ligurinis chloris;* Rowan, 1929, *Junco hyemalis;* Bissonnette, 1930, *Sturnus vulgaris;* Blanchard, 1941, *Zonotrichia leucophrys*).

Histologic changes.—Concomitant with the changes in size are changes in the histologic condition of the testis. These changes have been recorded for the species just mentioned, and they show that size is a reliable index of the histologic condition. Particularly apposite to the present study are the studies of Rowan on the Slate-colored Junco (*Junco hyemalis*) and the studies of Blanchard on the resident and migratory races of the White-crowned Sparrow (*Zonotrichia leucophrys*). The histologic changes during recrudescence which I have observed in the Oregon Junco are identical in nearly all details to those described and illustrated by Rowan for the Slate-colored Junco.

They agree in part with those described by Blanchard for the Nuttall White-crowned Sparrow. However, the difference in gonadial size between these species is marked.

The histologic changes may be represented by five readily delimited stages which correlate well with the size of the testis.

Stage 1. The size of the testis is at a minimum. In each tubule there is a well-defined row of small spermatogonia ("spermatogonies de premier ordre" of Loisel) close to the basement membrane. The nuclei are usually round, stain darkly, and characteristically show several nucleoli. The outlines of the cell bodies are not well defined in most of the sections, but occasionally the columnar shape of the cells is readily observable. Toward the middle of the tubule and adjacent to the row of spermatogonial nuclei, there are larger, lighter staining nuclei, which are distributed intermittently and show a delicate chromatin network ("spermatogonies de deuxieme ordre" of Loisel). There is no lumen.

The cells between the tubules are closely packed, and may be 4 to 6 cells deep between adjacent tubules. The cells adjoining the basement membrane of the tubule form one or two well-defined rows which completely surround the tubule. The cells in these rows have a small amount of cytoplasm and round or oval shaped nuclei with a well defined, single, centrally located nucleolus. The nuclei are close together and may be elongated in a plane parallel to the surface of the tubule. Some of the cells resemble strongly those of cuboidal epithelium because of the roundness of the nuclei, their regular arrangement, and the lack of any flattening of the cell. Between these rows of cells and in the interstices there are cells which resemble these, but there are also present a small number of cells that are epitheliod in appearance. Rowan calls the cells which invest the tubule, and those in the interstices which resemble them, connective tissue cells. The cells which differ from these are, according to Rowan, "reminiscent of true interstitial tissue but smaller in size" (1939:190). I agree with Rowan that at least two types of cells are present, and rather than say that the small cells are "reminiscent of true interstitial tissue," I regard them as interstitial cells. Their smaller size may be indicative of a lesser amount of activity.

The tunica albuginea is equal in thickness to the short diameter of a tubule, and contains many elongated nuclei.

Judging from Blanchard's descriptions (pp. 53-54) and photographs (pls. 5-6), her Stage 1 (inactive condition) and Stage 2 (first change from inactive condition) are equivalent to the stage just described for juncos. I question whether she could draw a sharp division between testes in Stage 1 and Stage 2. The only distinct characteristic differentiating the two which she gives (p. 53) is that in Stage 2 a "few cells resembling functional interstitial cells . . . are scattered irregularly among the cells of the nonfunctional type [interstitial cells?] which still form six to seven rows between the tubules." Blanchard states that Stage 2 corresponds roughly to "recrudescence" as described by Rowan (1929, p. 190), but a comparison of the two shows that Blanchard's Stage 2 is equivalent to Rowan's description of the winter testis. Rowan's "recrudescence" stage is equivalent to Stage 3 of Blanchard, both of which are definitely distinguishable from the winter testis.

Stage 2. Minor growth changes and variations occur in the winter testis and, as Blanchard found in the Nuttall White-crowned Sparrow, there is a slight increase in volume in the winter (see figure 80).

There has been a marked increase in the number of cells within the tubule. Many of the cells, some of which are primary spermatocytes, are approaching the center of the tubule, and a few

degenerating primary spermatocytes have already reached it. Occasionally mitotic figures are found in large spermatogonia. There still is no lumen.

Because of the increase in the size of the tubules, the connective tissue cells which surround them are extremely elongated and usually only two or three rows separate contiguous tubules. The areas between several adjacent but not contiguous tubules are filled mainly with large epithelioid cells which are interstitial cells. They have large vesicular nuclei with one or two prominent nucleoli. Mixed in with the interstitial cells in small numbers are connective tissue cells. The tunica albuginea is thinner.

This stage corresponds to Stage 3 of Blanchard and is equivalent to Rowan's description of "recrudescence" and to the poorly defined stage which follows "recrudescence."

Stage 3. In this stage the tubules have further increased in size, with the result that most of their surfaces are contiguous. The characteristic cell of this stage is the primary spermatocyte, and in most of the tubules a few of them at least are in that stage of synapsis in which the chromatin lies at one side of the nucleus. A few secondary spermatocytes may be present. Many spermatocytes are degenerating and desquamating cells are freguent in the center of the tubule. A definite lumen is not present, but in some tubules there are small spaces at the center suggesting the beginning of a lumen.

The interstitial cells reach their "maximum" development in the first part of this stage, judging from their numbers and appearance. The cells fill all the triangular spaces available between the tubules, and even occur along the sides of appressed tubules. The connective tissue cells which invest the tubules are extremely flattened and are usually only one or two cell layers deep. Connective tissue cells which resemble those in the previous stages (not investing the tubules), but whose nuclei are larger, are still mixed in with the groups of interstitial cells, but they are not as abundant as the interstitial cells. The tunica albuginea is thinner and more fibrous, with fewer connective tissue cells.

This stage corresponds to Stage 4 of Blanchard and is equivalent to Rowan's "2 mm. diameter" stage. There is complete agreement on the abundance of the interstitial cells at this stage.

Stage 4. From Stage 3 until breeding size is reached, the changes occur with great rapidity. Because of this rapid growth rate, the histologic pictures in testes of different sizes overlap greatly and it is not feasible to characterize accurately more than one stage.

Within the much enlarged tubules with their distinct lumens are secondary spermatocytes, spermatids, and metamorphosing spermatids. At first there is no orientation of the metamorphosing spermatids, but they soon move away from the lumen toward the Sertoli cells and become oriented with their heads toward the basement membrane. As the mature spermatozoa are formed, they are grouped into loosely arranged bundles.

The tubules have enlarged and meet along most of their surfaces. This leaves mainly the triangular spaces, where several tubules fail to meet, for the interstitial cells. The interstitial cells are plentiful, yet reduced in number from Stage 3. Their appearance is identical except for those few which are pressed between contiguous tubules. A few connective tissue cells are present in the interstices with the interstitial cells, and those surrounding the tubules are so flattened that the nuclei almost appear as solid lines. Capillaries are conspicuous and are often filled with corpuscles. In the earlier stages capillaries are rare among the tubules. The tunica albuginea is thin and fibrous.

This stage is equivalent to Rowan's description of testes prior to the attainment of breeding, and comprises Blanchard's Stages 5 and 6. I do not think that Blanchard's Stage 5 is adequately delimited. From her descriptions and photographs, it seems to be more correctly a later phase of Stage 4. It is noteworthy in this connection that on her graphs of the early changes in the testis in both races, Stage 5 is found infrequently when compared with the occurrence of Stage 4, and it occurs practically at the same time as Stage 4.

Stage 5. This is the breeding stage of the testis. The tubules have reached their maximum size and each shows a large, well defined lumen. Mature spermatozoa are closely packed in bundles and their elongated corkscrew-shaped acrosomes are embedded in the Sertoli cells. The bundles of spermatozoa are arranged with extreme regularity along the radii of the tubule. In most of the testes which have been sectioned, free mature spermatozoa were observed and in several where the epididymis has been sectioned, spermatozoa were observed in the lumens of the tubules of the epididymis. Rowan found no free spermatozoa in a male that was mated and engaged in nest building and concluded that "liberation of the sperms apparently does not occur till the time of sexual intercourse."

In recent studies on the motility of spermatozoa in the fowl, Munro (1938) found that the spermatozoa rarely show motility until they have reached the epididymis and show more motility in the vas deferens. It is highly probable that this is true in juncos. Examination of the undiluted fluid of testes at breeding size has shown that numerous mature spermatozoa are present, but that they are not motile. It seems unlikely that Rowan's supposition that the spermatozoa are liberated

from the bundles in the tubules at the time of coitus is correct. It seems rather, that the spermatozoa are freed before coitus and acquire motility and a capacity for fertilization while traversing the duct. More data, however, are needed to establish Munro's observations for juncos. Blanchard has observed mature spermatozoa free in the lumen in the White-crowned Sparrow, and Bissonnette has also demonstrated them in the Starling.

In this stage blood vessels and interstitial cells occur in the small triangular spaces between the tubules. The interstitial cells are similar in appearance to those seen in the earlier stages, but they are reduced in number from Stage 4, and are almost restricted to these triangular areas. Only occasionally are any seen between contiguous surfaces of the tubules. It should be pointed out that although the interstitial cells are reduced in number on each section when compared with sections of testes at Stage 2 and Stage 3, it may be that they are not reduced in number in the whole testis. The volume of the testis in breeding condition may be 100 times the volume of the testis in Stage 2. In addition, there is no reason for supposing that the interstitial cells are any less functional than they are in the earlier stages.

Connective tissue cells which invest the tubules are similar to those in Stage 4, but they are not common in the interstices. The tunica albuginea is extremely thin. The conspicuousness of the blood vessels at this stage is noteworthy.

In the testes of a breeding bird Rowan states (1929:192) that the interstitial cells are "few in number," are "to be found only in some of the triangles between the tubules" and "when they are to be seen they are generally large and easily recognized." This agrees with my observations. Rowan, however, implies that they are scarcer than I have found. Blanchard records the presence of interstitial cells in the triangular spaces between the tubules in testes in breeding condition, but makes no further observations on them.

THE GONADS OF MIGRANT MALES

Gross changes.—The gonads of the migrants were collected from the time that they arrived at Berkeley in October until they migrated at the end of March. In this period the testes only develop to Stage 3, as compared with the attainment of breeding size in the resident race. Through November, December, January, and early February, the testes grow only slightly from their minimum size of 0.5 mm.^{3} to attain an average volume of 1.0 mm.^{3} on February 10. From this date until the end of March, when migration occurs, there is a gradual increase in size with the attainment of an average volume of 4.2 mm.^{3}. These changes are illustrated in the graph (figure 80).

Histologic changes.—The histologic changes and the average volumes for each stage are approximately the same in the residents and migrants. However, there is marked difference in the time of the attainment of the stages and in their duration.

In Stages 2 and 3 the interstitial cells are abundant and just as numerous in the resident race as in the migratory race. When the migrants leave Berkeley, their testes are either in Stage 2 or Stage 3. Blanchard's studies on the interstitial tissue in the resident and migratory races of the White-crowned Sparrow agree with my observations in the Oregon Junco.

The occurrence of abundant interstitial tissue in a resident bird does not invalidate Rowan's conclusion on the role of the interstitial cells in a migrant, but as will be discussed later, other available evidence indicates that the gonads may not be an essential factor in the stimulus for the spring migration. Rowan (1932) has shown that this is true for the fall migration.

COMPARISON OF DATE AND RATE OF ATTAINMENT OF GONADIAL STAGES IN RESIDENTS AND MIGRANTS

The differences in date of attainment and duration of Stages 1, 2, and 3 are well illustrated in figure 80. A brief summary of these differences follows. (1) Stage 1 is of shorter duration in the resident birds; it ends about January 19 whereas in the migrant it does not end until February 21. (2) Stage 2 has an average duration of 15 days, and ends about February 3 in the resident; in the migrant it has an average duration of 28

days, and ends about March 20. (3) Stage 3 in the resident has an average duration of 24 days, and ends about February 27. In the migrant no material is available to indicate when Stage 3 ends. From Rowan's data, Slate-colored Juncos arrive at Edmonton, Alberta, early in April with their gonads in Stage 3. (4) After Stage 3, in the residents, the growth rate is so rapid that full breeding condition is reached by the time the migrants leave. An adequate number of testes of these later stages is not available, and it is not possible to calculate the average duration of Stage 4 or Stage 5. An estimation of the length of Stage 4 is 25 days; Stage 5 appears usually at the end of March.

This marked contrast in development of the gonads under identical external conditions has also been demonstrated in the experiments on induced migration. These observations on the gonads of wild juncos agree with similar observations of Blanchard on the White-crowned Sparrow.

INDIVIDUAL, RACIAL, AND ANNUAL VARIATION IN THE GROWTH OF THE TESTES

Individual.—The residents show more individual variation in the rate of growth of the testes than do the migrants. This is to be expected because of the rapidity of growth of their testes in a short period, and also because their breeding season is longer. The migrants only go through a small part of their testicular growth on the wintering grounds, and due to the small range in volume and the slow growth rate at this time, one does not expect nor observe a large amount of variation. The graphs (figures 80 and 81) show the large amount of variation in volume which is found in the testes of residents collected on any one day. Variation is greatest when the testes are first changing from the winter condition, and after Stage 3 when growth is extremely rapid.

One cause of the variation is possibly the difference in age of the birds. In the samples taken, there probably were birds ranging in age from 1 to 4 years and also immatures. In juncos it is impossible to distinguish the immatures from the adults after December. By that time the skull is usually ossified completely and the plumages are essentially identical. There is no evidence from Blanchard's work, where immatures and adults are separable until March, that any significant and consistent differences occur in the early growth of the testes of immatures and adult White-crowned Sparrows. When it was possible to separate adults and immatures, their testes were usually in the winter condition and no significant differences were found. When subjected to experimental treatment, the immatures and adults show no difference in response.

Racial variation.—Because of the great differences in the distance from Berkeley of the breeding grounds of the several migratory races of juncos, it was thought that it would be worthwhile to determine whether there are differences in testicular growth in these races on the wintering grounds and whether there are differences in the stage of the testis when migration was begun. The pertinent data were analyzed, but show that there are no statistically significant and consistent differences among the races on these points. For this reason a composite growth curve was made which includes all the migratory races (figure 80).

Annual variation.—It was not the purpose of this study on the gonads to analyze the annual differences in the growth of the testis in any of the races. The birds which were available were needed for the experiments. Blanchard, however, studied the annual variation in the attainment of the various stages in the early part of the testis cycle. She concluded that general clemency of weather conditions, especially temperature, for a period of four to nine weeks, depending on the year, beginning December 21 "may allow the cycle to proceed at a rate limited only by the hereditary make-up of the bird; exceptionally unfavorable temperatures can hold back the same hereditary

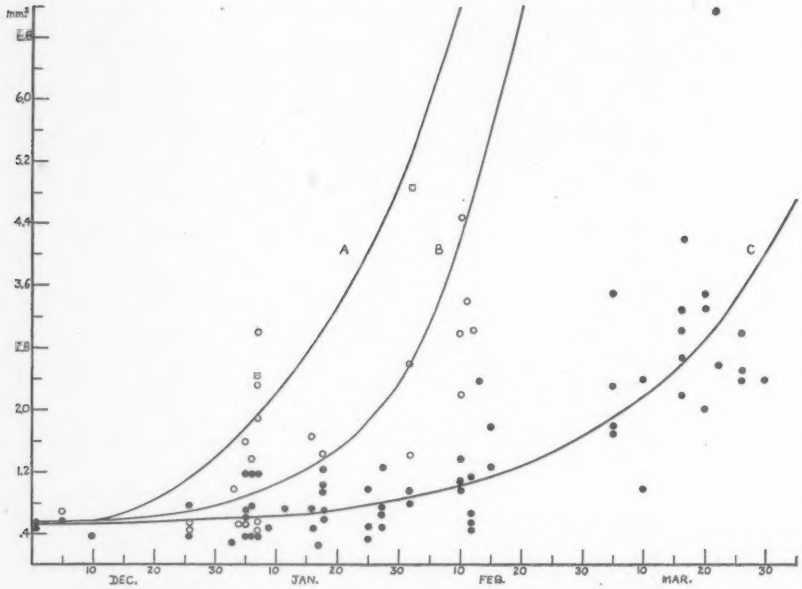

Fig. 80. Volumes of early stages of the testes of resident and migrant Oregon Juncos. A, estimated curve for migrants in induced migration Experiment 2 (no points plotted); B, calculated curve for wild residents; C, calculated curve for wild migrants. Circles=points for curve B; dots=points for curve C.

process . . . " She concludes further (p. 75): "It seems nearest to the truth, then, to think of the gonad cycle as the expression of an inherent annual rhythm . . . which may be modified in part by environmental conditions but it is by no means entirely dependent upon them for its beginning or its general subsequent course." Because of the direct bearing of Blanchard's conclusions on the problem of the annual stimulus for bird migration it is necessary to discuss her data and conclusions.

In comparing the gonadial cycles of different years it is imperative to establish the normal, average gonadial cycle for each year. To do this, one should have a large number of gonads throughout the periods which are being compared and calculate the most probable growth curve. Blanchard did not calculate the average growth rate for each year. Stage 5 (of Blanchard; note comments on identity of Stage 5 on page 253) "is the earliest point in the cycle which is represented by sufficient material to be comparable in all four years (p. 57)." In 1936, two testes were collected at Stage 5; in 1938, four; in 1935, two; in 1937, five. The date of attainment of Stage 5 in these years is determined by choosing that date on which "one or more gonads in Stage 5" is first collected. The date is chosen, therefore, without regard for the individual variation which occurs, and probably does not represent the average for the population. I agree with Blanchard that variations may occur from year to year in the gonadial cycles of birds, but before we are ready to define these variations precisely, we should collect many samples in each year and over a period of years. Then we would be more justified in comparing the growth rates for these years. What the cause of these variations would

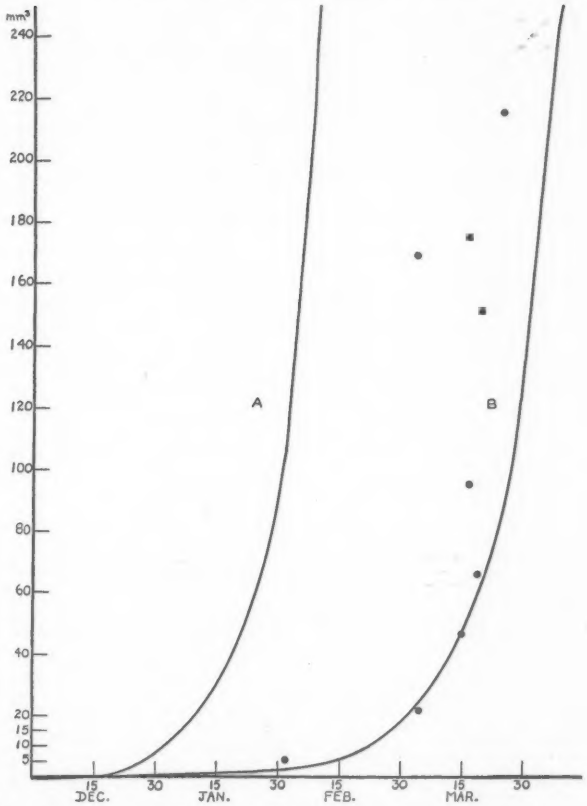

Fig. 81. Volumes of later stages of the testes of resident Oregon Juncos. A, estimated curve in Experiment 2; B, calculated curve for wild birds. Dots=points for curve B; no points plotted for curve A.

be, however, is an extremely complex and difficult problem. The external factors which impinge upon the physiological state of the bird are just beginning to be studied, and concerning the problem of how these factors effect changes in the physiological state of the bird we have only a few theories.

If we accept Blanchard's conclusion (p. 74) that as far as the Nuttall White-crowned Sparrow is concerned, "temperature is the most important single factor lying at the ultimate source of annual variations of the gonad cycle," I cannot see that it follows that it is "extremely doubtful whether the abundant means [experiments involving increases in day length] which have been discovered for upsetting the physiological balance of captive birds should be accepted as possessing any bearing whatever on the factors which control the cycle under natural conditions" (p. 76). Blanchard has presented evidence to show that annual variations in temperature can modify the rate of growth of the testis in a critical period; more data is necessary to prove this conclusively, and I think that it could be proven. However, Blanchard presented no direct evidence for

her view that the length of day should not be accepted as possessing any bearing on the problem of the factors which control the gonadial cycle under natural conditions.

TESTIS SIZE AND FAT DEPOSITION

In the migrant races the growth of the gonads is accompanied by the deposition of subcutaneous and intraperitoneal fat. The classes which are used to denote the fat condition have been described. Although there is considerable individual variation in the fat condition as the gonads develop, it is generally true that the migrants become progressively fatter as the testes grow so that they are usually in the "heavy" class at the time of migration. In the resident race not one individual has been observed which had a heavy deposit of fat. Most of the resident individuals collected in midwinter have a "little" fat; a few only have been taken in the five years of study which have had a "medium" deposit of fat.

THE HISTOLOGY OF THE GONADS OF EXPERIMENTAL BIRDS

Induced migration experiments.—The gonads of the experimentals are similar to those of wild birds in histologic detail and in the volumes of the testes in each stage. The rate of growth of the testes, however, differs markedly. In the experiments, the residents and migrants reach a stage of development which normally takes 100 days in about 50 days. The testes of the residents grew in Experiment 2 from the minimum volume of 0.5 mm.^{3} on December 10 to a volume of 224 mm.^{3} on February 2. The testes of the migrants grew from the same minimum volume to an average volume of 10 mm.^{3} on February 2. The growth rate in each case was a little over twice the normal rate. An equally spectacular difference in the response of the testes of residents and migrants under identical environmental conditions was shown in Experiments 1 and 3 (see tables 1, 3, 8, and 10 and figures 80 and 81).

Delayed migration experiments.—Histological studies of the gonads of birds which were sampled in connection with these experiments confirm the previous conclusion that they were in breeding condition and demonstrate that this condition of the migrant testes is identical histologically with breeding condition in the residents.

THE GONADS OF THE FEMALE

The ovaries which have been collected do not show any readily discernible differences which would aid our understanding of the problem of the role of the gonads in the regulation of migration. If we can solve this problem in the male, where the situation seems to be less complex, we will probably be nearer to the solution of the problem in the female. A few observations, however, have been made which are worthy of mention.

There is a large amount of variation in the size of the largest follicle, which Rowan uses as a criterion for ovarian development, in the ovary in winter. (Rowan's observations were made on only a few ovaries.) As spring approaches, there is a general tendency for the ovaries to show more enlarged ova. When the migrants leave Berkeley and the residents are ready to breed, the condition of the ovary is extremely variable, but on the whole the ova are increased in size over the winter condition. The oviducts show no gross changes. As is well known in other birds, most of the development of the ovary takes place extremely rapidly only a short time before ovulation. The mechanism which brings about this change is not known.

In the induced migration experiments, the ovaries show only a slight response to the increasing day lengths, and there is no gross change in the oviduct. The majority of the females need a longer time than the males for the deposition of fat, and only in Experiment 3 were good results obtained in inducing the females to migrate. These

facts, in contrast to those in the male, suggest that in the female behavior may play a part in regulating the development of the ovary from its condition before breeding until ovulation occurs. In the delayed migration experiments the ovaries show a slight advance in development over their state in March, and the oviducts are slightly enlarged. When compared with the ovaries and oviducts of birds which are laying or incubating in May, however, the advance in development is negligible. A behavioristic stimulus for the late and rapid development of the ovary prior to nesting again suggests itself.

DISCUSSION AND CONCLUSIONS

From the results of the preceding studies it seems that both external and internal factors are involved in inducing the spring migration of the Oregon Junco.

The external factor of prime importance is the length of day, and the regular increases in the day length during the winter and spring effect changes in the physiological state of the bird. These changes are manifested by the growth of the testes, the increase in the secretory activity of the pituitary gland (unpublished data), and the deposition of large amounts of subcutaneous and intraperitoneal fat. Because of these changes, the physiologic state prior to migration is so altered from that which prevailed in midwinter that it provides the internal stimulus which releases the nervous mechanism that controls migratory behavior. It seems, furthermore, that the total physiological state is important and not the physiological condition of one organ alone, such as the gonad. Although the condition of each part makes up the whole, some part, such as the pituitary, may be sufficiently dominant in the physiology of the organism ultimately to determine the total physiological state and hence the type of behavior exhibited.

In the induced migration experiments the juncos undertook a northward migration two months earlier than usual because they were brought into a physiological and psychological state similar to that which prevails at the normal time of migration. When this physiological state was not reached in some individuals, as indicated by the lack of a heavy deposition of fat, they did not migrate. Although increases in day length were employed in the experiments to induce gonadial growth, under natural conditions the period of relatively constant day lengths prior to December 21 may be a factor in the initiation of gonadial development.

If the spring migration is only under the direct control of recrudescing gonads, as Rowan and others maintain, the migrants that were released with their gonads in breeding condition in the experiments on delayed migration should not have migrated. When compared with wild, migratory juncos that had been on their breeding grounds for several weeks, the released migrants had one thing in common with them, namely, gonads of approximately the same condition. They differed from them in several respects: they were not on their normal breeding grounds; they had been forced to flock together in captivity; they had not expended the energy required by migration; and they were heavily laden with fat. Because of these differences, the physiological and psychological state of the migrants that were released was sufficiently similar to that state at the normal time of migration to prevent immediate breeding and to induce migration two months later than usual. When this state was not sufficiently similar to that at the normal time of migration, as indicated by an inadequate amount of stored fat, the juncos failed to migrate. This was demonstrated by 2 out of a total of 87 juncos that were released in the three experiments.

According to the results of Rowan's experiments, juncos that have gonads in breeding condition do not migrate, yet the juncos that were released in our delayed

migration experiments had gonads in breeding condition and they did migrate. A possible explanation of the discrepancy in results has been offered (Wolfson, 1940).

To relate the recent discoveries in endocrinology to migration, Bissonnette (1937) proposed a theory of migration involving the relationship of the gonads and pituitary. He states that there is an inherent rhythm of activity of the pituitary and that the gonads, therefore, are controlled by the cyclic activity of this gland. Birds migrate in the fall due to the regression of pituitary activity and do not breed on the wintering grounds because this gland, and hence the gonads, remain in the "refractory phase." On recovery of the pituitary the birds are stimulated to migrate before, or while, their gonads recrudesce. Eventually the recrudescence of the gonads reaches such a point as to induce migration to stop and mating to occur. Detention in the winter range, therefore, should be followed by a breeding cycle there. The results of the experiments in delayed migration do not support Bissonnette's contention on the role of the gonads in migration. Although the juncos were detained on their wintering grounds, and their gonads attained breeding condition, they did not breed when they were released, but they migrated.

It seems that the gonads may not be an essential part of the internal stimulus for the spring migration, but rather that the pituitary is the primary controlling factor. I think that the recrudescence of the gonads may be looked upon as a concomitant result of the increase in the secretory activity of the pituitary gland, which probably also results in the increased activity of other endocrine glands, such as the thyroid and adrenals. In relation to migration, the important effect of the changes in the pituitary is not the recrudescence of the gonads, but the production of a physiological state that will enable the bird to meet successfully the energy requirements of migration. If the physiological state is such that a bird could not successfully meet these requirements, migration would not occur because the nervous mechanism which controls migratory behavior would not have been released. Therefore, the most important manifestation of a readiness to migrate is the presence of a large amount of stored fat.

Further evidence suggesting that the gonads may not be an essential part of the physiological state which provides the stimulus for the spring migration is the fact that castrated birds will migrate northward and will return to their wintering grounds in the fall. The results of studies of Dr. John T. Emlen (personal communication) on Gambel White-crowned Sparrows are the basis for this statement. Castration was performed prior to migration, and three birds that were retaken in subsequent winters showed no signs of gonadial tissue. Hann (1941) has shown also that several species of fringillids that were castrated undertook a spring migration.

In addition, the fact that castrated birds will migrate and juncos will migrate with their gonads in breeding condition seems to indicate that migration and breeding are separate entities in the life cycle of a bird, migration being independent of the breeding cycle. One can postulate that in the phylogeny of a species, migration was imposed on an already existing breeding cycle and "timed" to it through the action of the environment and natural selection.

It would seem, therefore, on the basis of the foregoing discussion, that Rowan's theory, which states that the stimulus for the spring migration is the secretion of the interstitial cells in the early stages of recrudescence, is not tenable for the Oregon Junco, and probably not for other birds.

Whether there exists an inherent or genetically fixed rhythm of the endocrine system which is independent of environmental factors for its initiation and subsequent course as maintained by Blanchard (1941) and Woodbury (1941) and suggested in part by Bissonnette is difficult to say. It is known that the maximum activity of the

pituitary and gonads such as occurs in the breeding period cannot be maintained indefinitely; these glands will automatically regress after a period of peak activity. I agree with Bissonnette that this automatic regression is inherent in the endocrine system, and further, that a period of refractoriness during which the pituitary and gonads cannot be stimulated by experimental increases in day length follows this regression. An experiment which was performed to induce gonadial recrudescence in the fall indicates that such a period exists in juncos (unpublished data). In a strict sense this part of the cycle is inherent in that it is due to the inherent qualities of the glands themselves. However, when the endocrine system has recovered to the point where it will respond to changes in day length, I do not think that the subsequent changes in the gonads and pituitary occur automatically and independently of environmental conditions as regression does, but that these changes are under the direct influence of the length of day and modifiable by other factors in the environment such as temperature and food (Kendeigh, 1934, 1941). If this were not true it would be difficult to explain the nearly perfect coincidence of migration, or of nesting, in birds hatched one to three months apart. The inhibitory effect on gonadial growth when birds are subjected to short, constant day lengths, as shown by Rowan (1929, 1937) and Kirschbaum and Ringoen (1936), would tend to support the view that the changes in day length influence the course of development of the gonads. Further, the fact that the pituitary of the Oregon Junco responded to increases in day length in December and January, and migration was induced two months earlier than usual seems to show that the recovery of the pituitary after the refractory period is not genetically fixed, but rather that it is under the control of the environment.

It was demonstrated in the Oregon Junco that gonadial recrudescence as well as the activity of the pituitary (unpublished data) differs in residents and migrants under the natural conditions of winter. The existence of an automatic, inherent rhythm could explain this difference. However, it may also be explained by a difference in threshold of response to the length of day. That this difference in response could be produced two months earlier than usual by artificial increases in day length supports this view. The fact that resident and migratory races of White-crowned Sparrows responded to experimental increases in day length (unpublished data) and showed a similar gonadial response to that obtained in resident and migratory juncos, argues against Blanchard's contention that the difference in the recrudescence of the gonads of these races is due to an automatic, inherent rhythm.

Although a single factor of the environment—length of day (and conversely length of night)—has been stressed in this study as a regulator of the endocrine system in the Oregon Junco, there is no reason to believe that it is the only environmental factor involved in this and other species. That it is a primary factor in many species is generally agreed, but certainly other factors in the environment such as temperature (and weather conditions in general), food, and the presence of other individuals of the species play some part in controlling and modifying the activity of the endocrine system. In some species it is known that one or more of these factors may be the primary controlling factor, and not the length of day (see Marshall, 1942).

Finally, it must be emphasized that no claim is made for the general application of the conclusions which have been presented for the Oregon Junco. The marked difference between resident and migratory individuals of the same species in their gonadial response to light is indicative of the caution which must be exercised in assuming general application of conclusions. It is to be expected that there will be differences among species, and even among members of a species, in their response to environmental conditions and the internal factors which regulate spring migration.

SUMMARY

Resident and migratory races of the Oregon Junco (*Junco oreganus*) were employed in experiments in induced and delayed migration. Three experiments in induced migration involved the release of migrants and residents in late January or February after they had been subjected to artificial increases in day length beginning early in December. Those individuals which responded to the light treatment, as evidenced by recrudescence of gonads and assumption of fat, undertook a northward migration two months earlier than usual. Three experiments in delayed migration involved the retention of migrants at Berkeley until the end of May or early in June, when they were released with their gonads in breeding condition. The results indicate that the juncos undertook a northward migration two months later than usual.

Studies of the gonads have shown that residents (*Junco oreganus pinosus*) and migrants (*J. o. thurberi, J. o. shufeldti, J. o. montanus,* and *J. o. oreganus*) differ in their gonadial cycles, although they flock together in the winter and are subjected to the same environmental conditions. The testes of the residents recrudesce earlier and at a faster rate than those of the migrants. When the migrants leave Berkeley at the end of March, their testes have an average volume of 4 mm.^{3} whereas the testes of the residents have an average volume of 220 mm.^{3} This difference in growth rate has also been demonstrated under experimental conditions. Histologically the testes of residents and migrants are identical. Interstitial cells occur in the testis at all stages from the winter condition to the breeding condition. They appear to be more abundant in the early stages of recrudescence, but this may be due to the small volume of the whole testis in these early stages. Individual variation in size of testis is marked in the residents during the period of rapid growth prior to breeding. No significant variation in testis growth and size at time of departure is found among the migratory races.

Histological studies of the gonads of experimental birds revealed that the gonads were at breeding condition at the time of release in the delayed migration experiments and that in the induced migration experiments the testes were histologically identical to those at the normal time of migration.

In the migrants there is a heavy deposition of subcutaneous and intraperitoneal fat at the time of migration. The residents show no such deposition of fat.

The ovary shows little change from winter to spring compared with its development immediately before laying. In the experiments the ovarian response was negligible.

On the strength of our present knowledge of the relation of the hypothalamus to sleep and the gonadotropic activity of the pituitary, the following explanation of how increases in day length can cause recrudescence of the gonads under experimental and natural conditions is advocated. As the days increase in length, birds are awake for longer periods of time because the state of wakefulness, at least in some birds, is a conditioned response to light; the concomitant activity of the hypothalamus causes an increased production, or release, or both, of the gonadotropic hormones of the pituitary; these in turn stimulate gonadial recrudescence.

It is concluded that internal and external factors regulate the spring migration of the Oregon Junco. The external factor of prime importance in juncos is the length of day. As the days increase in length in the winter, the birds are awake for longer periods. Associated with these longer periods of wakefulness is an increase in the duration of activity of the hypothalamus (Wolfson, 1941). This causes an increase in the production, or release, or both, of gonadotropic and other hormones from the pituitary. These hormones produce physiological changes in the bird, as exemplified by the

recrudescence of the gonads and the deposition of large amounts of fat. Because of these changes, the physiological state prior to migration is so altered from that which prevails in midwinter that it provides the internal stimulus for the spring migration. The internal stimulus induces the actual migration by releasing the nervous mechanism which controls migratory behavior.

LITERATURE CITED

Bissonnette, T. H.
1930. Studies on the sexual cycle in birds. I. Sexual maturity, its modification and possible control in the European starling (*Sturnus vulgaris*). Amer. Jour. Anat., 45:289-305.
1937. Photoperiodicity in birds. Wilson Bull., 49:241-270.
Bissonnette, T. H., and Chapnick, M. H.
1930. Studies on the sexual cycle in birds. II. The normal progressive changes in the testis from November to May in the European starling (*Sturnus vulgaris*), an introduced, non-migratory bird. Amer. Jour. Anat., 45:307-343.
Blanchard, B. D.
1941. The white-crowned sparrows (*Zonotrichia leucophrys*) of the Pacific seaboard: environment and annual cycle. Univ. Calif. Publ. Zool., 46:1-178.
Hann, H. W.
1939. Relation of castration to migration in birds. Bird-Banding, 10:122-124.
Kendeigh, S. C.
1934. The role of environment in the life of birds. Ecological Monographs, 4:299-417.
1941. Length of day and energy requirements for gonad development and egg-laying in birds. Ecology, 22:237-248.
Kirschbaum, A., and Ringoen, A. R.
1936. Seasonal sexual activity and its experimental modification in the male sparrow, *Passer domesticus* Linnaeus. Anat. Rec., 64:453-473.
Loisel, G.
1900-1901. Études sur la spermatogénèse chez le moineau domestique. Introduction. I. La préspermatogénèse. Jour. de l'Anat., 36:160-185; 37:193-216.
Marshall, F. H. A.
1942. Exteroceptive factors in sexual periodicity. Biol. Rev., 17:68-90.
Miller, A. H.
1941. Speciation in the avian genus *Junco*. Univ. Calif. Publ. Zool., 44:173-434.
Munro, S. S.
1938. Functional changes in fowl sperm during their passage through the excurrent ducts of the male. Jour. Exp. Zool., 79:71-92.
Ringoen, A. R., and Kirschbaum, A.
1939. Factors responsible for the sexual cycle in the English sparrow, *Passer domesticus* (Linnaeus). Ocular stimulation and spermatogenesis; effect of increased light ration on ovarian development. Jour. Exp. Zool., 80:173-191.
Rowan, W.
1929. Experiments in bird migration. I. Manipulation of the reproductive cycle: seasonal histological changes in the gonads. Proc. Boston Soc. Nat. Hist., 39:151-208.
1932. Experiments in bird migration. III. The effects of artificial light, castration and certain extracts on the autumn movements of the American crow (*Corvus brachyrhynchos*). Proc. Nat. Acad. Sci., 18:639-654.
1937. Effects of traffic disturbance and night illumination on London starlings. Nature, 139: 668-669.
Watson, A.
1919. A study of the seasonal changes in avian testes. Jour. Physiol., 53:86-91.
Wolfson, A.
1940. A preliminary report on some experiments on bird migration. Condor, 42:93-99.
1941. Light versus activity in the regulation of the sexual cycles of birds: the role of the hypothalamus. Condor, 43:125-136.
Woodbury, A. M.
1941. Animal migration—periodic-response theory. Auk, 58:463-505.

Museum of Vertebrate Zoology, Berkeley, California, August 28, 1942.

UNUSUAL NUMBERS OF DEAD BIRDS ON THE WASHINGTON COAST

By DONALD L. McKERNAN and VICTOR B. SCHEFFER

In the month of May, 1942, great numbers of dead sea birds were observed on certain beaches along the coast of the state of Washington. While it is not uncommon to find an occasional murre, shearwater, or gull that has succumbed from the effects of crude oil or other injury, the number of birds thus found at a given time would perhaps number one or two per mile of coast line. Greater numbers are observed after severe storms. In the present instance, however, the influx of bird carcasses was not preceded by a period of stormy weather, and there were attendant circumstances that lead us to believe that the birds were poisoned by a marine organism.

A slight increase in the numbers of dead birds along the beaches was first noted on May 5, while the senior author was investigating a sudden outbreak of paralytic shellfish poisoning. The State Department of Fisheries had received many reports that cats and chickens were dying along the Washington beaches from eating the viscera of razor clams. Three humans living on the Olympic Peninsula and several on Vancouver Island were killed by the same type of poisoning. In connection with the death of chickens the senior author examined the digestive organs of several and found uniform symptoms in each: the entire length of the intestine was greatly inflamed, and the blood vessels were enlarged and sharply outlined. The inflammation, followed by death, was experimentally produced in chickens by feeding them offal from razor clams dug on May 5.

The epidemic of clam poisoning is believed to have been caused by the planktonic organism, *Gonyaulax catenella*, specimens of which were found in razor clam stomachs at Copalis. *Gonyaulax* is a microscopic organism known to "bloom" under certain circumstances in such numbers as to tinge the water red and produce for brief periods the condition known as "red tide." To the best of our knowledge such a tide was not actually observed along the Washington beaches.

Long windrows of pelagic barnacles, *Lepas fascicularis* (identified by Dr. Dora P. Henry), appeared on the beaches during the month of May. These excited the interest of local residents, most of whom stated that they had not previously noted the species. In conversation with Dr. Harvey C. McMillin, however, we were told that while he was investigating shellfish problems on the Pacific beaches he collected eight quarts of *Lepas fascicularis* on the Washington coast in 1929 and observed them on the Oregon coast in 1931. The possibility is suggested that the barnacles, being plankton feeders, may have consumed large quantities of *Gonyaulax*.

On Copalis Beach, on May 5, four dead adult gulls (unidentified species) were dissected and their intestines found to present the same inflamed condition as that of the chickens previously examined. Two of the gulls had eaten small crustacea and clams, represented by broken bits of carapace and shell. Three dead White-winged Scoters (*Melanitta deglandi*) examined on May 7 had inflamed intestines. The stomachs of two of these birds contained fragments of small crabs and several snails (*Alectrion perpinguis*). Several other birds examined had empty stomachs and inflamed intestines. Of all the birds examined, none showed outward evidence of injury.

On May 7 fifteen to twenty dead birds were noted in ten miles of Copalis Beach, including California Murres (*Uria aalge californica*), Pacific Loons (*Gavia arctica pacifica*), gulls, White-winged Scoters, a Tufted Puffin (*Lunda cirrhata*), and two Sooty Shearwaters (*Puffinus griseus*). On May 13 Mr. Howard Harris, State Fish-

eries Inspector, counted thirteen dead birds on seven miles of Grayland Beach. On May 17 Mr. Harris and Mr. Stan Phillips, Chief Inspector, estimated about 1,500 dead birds along fifteen miles of Grayland Beach.

On a five-mile strip immediately south of Grayland on May 19 Dr. Kelshaw Bonham and the junior author counted 127 dead birds. About one dozen were fresh and near the surf, the remainder were a few days to several weeks old and were higher on the beach. The tally was as follows:

California Murres	81	Herring Gulls	2
Pacific Loons	23	Western Gulls	2
Sooty Shearwaters	12	Pacific Fulmar	1
Unidentified gulls	5	Tufted Puffin	1

Over a measured mile on Copalis Beach, on May 21, 189 dead birds were counted but were not tallied by species. At this rate seven times the number were present on Copalis Beach as on Grayland Beach two days previously. Fred Menath, operator of a hotel at Copalis, stated that in twenty years' experience he had not seen as many dead birds at one time.

On May 26, Grayland Beach was again examined and 85 dead birds were found along a three-mile strip, including 50 California Murres, 15 Pacific Loons, 15 Sooty Shearwaters, and 5 unidentified gulls. On the same beach on May 28 very few newly killed birds could be found; the most recent birds appeared to have been dead for a week or two. On June 5 only 2 loons and 3 California Murres were counted along fifteen miles of beach. On June 10 four dead birds were found in ten miles of Grayland Beach, namely, 2 California Murres, 1 White-winged Scoter, and 1 loon. On June 14 a Black-footed Albatross (*Diomedea nigripes*) was found dead with a broken wing on the beach; no other dead birds could be found. The beach was barren of dead birds on June 16 to 18. Birds found in the early part of May were for the most part fresh and appeared to have died shortly before appearing on the beach, while those found later in May seemed to have been dead for some time. It is probable that the causative agent had disappeared before May 25. No freshly killed birds were in the group counted on May 26; all had been dead for at least a week. The counts on the various ocean beaches indicate that the greatest numbers washed ashore between May 17 and May 26.

Fishermen reported large numbers of dead birds floating about ten to twenty miles off the Washington coast from May 5 to May 15. These may have been washed upon the beaches later in the month. There were also reports by halibut fishermen of large numbers of "divers" and "whale birds" (identified on further questioning as murres and shearwaters) floating dead on the water about 30 miles offshore in Hecate Strait, British Columbia, from about May 25 to June 12.

The *Gonyaulax* bloom had subsided by May 16 on the Washington coast, and because there was a definite lag in the appearance of dead birds on the beaches from a few days to several weeks from their death, it seems more than coincidental that the peak of occurrence of dead birds was about two weeks after the crest of the red tide organisms. About two weeks after the disappearance of *Gonyaulax* the numbers of dead birds found on the beaches and seen off the Washington coast began to decline.

The available evidence leads to the conclusion that the birds probably were killed by toxic marine organisms of the group Dinoflagellata. It is our belief that small fish and crustacea near the area of occurrence of the red tide had been feeding on a diet excessively rich in organisms of the *Gonyaulax* type, and that birds subsequently

feeding on the fish and (or) barnacles and other shellfish were the victims of secondary poisoning. It has seemed desirable to place our observations on record as a clue to ornithologists who may, at a future date, have an opportunity to investigate bird mortality of a similar nature. Further information on the subject of paralytic shellfish poisoning is given by Hermann Sommer and K. F. Meyer (Mussel Poisoning—A Summary. 1941. Calif. State Dept. Pub. Health, Weekly Bull., 20, 1941:53-55).

State of Washington Department of Fisheries and United States Fish and Wildlife Service, Seattle, Washington, August 17, 1942.

A LIFE HISTORY STUDY OF THE WHITE-TAILED KITE

By ALBERT C. HAWBECKER

Since the preparation of an earlier article on the White-tailed Kite (Hawbecker, 1940), it has been found possible to spend more time in the field and consequently to make a more complete study. Easy accessibility to the two pairs most studied has been responsible for this, as these birds have nested for three seasons within a few minutes' drive of my office. Three winter seasons are also covered in this study. It has been found necessary to include some of the data from the first article for comparison, and some points brought out there have been enlarged upon, but generally repetition is avoided. All of the first-hand material included herein was gathered in Santa Cruz County.

Three pairs of kites were studied and shall henceforth be designated by number: No. 1 was situated just west of the small settlement of Corralitos. It was studied through part of the nesting season of 1939 but it left and has not returned, probably because of the interference by man. No. 2 is situated about one mile west of Watsonville, and No. 3 is situated approximately one-fourth mile south of No. 2. A total of seven pairs has been reported within a radius of a few miles of Watsonville, and others have been rumored or suspected, but only four pairs have been observed with any care.

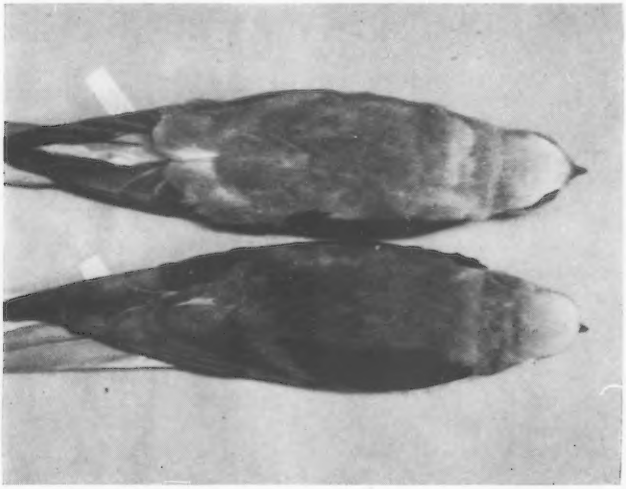

Fig. 82. Skins of White-tailed Kites, showing normal differences in coloration of the sexes: male above, female below.

The White-tailed Kite (*Elanus leucurus majusculus*) has been well described and pictured by others, but sexual differences do not seem to be well understood. Watson (1940) suggests that the female is the larger, but this is not borne out by measurements of nine males and seven females in the collection of the California Academy of Sciences. The following average measurements in millimeters were obtained. Males: wing, 309; tail, 184; tarsus, 42.5; bill (chord of exposed culmen excluding cere), 18.5.

Females: wing, 307; tail, 183; tarsus, 41.3; bill, 19.2. It can be seen that only in bill length is the female larger. Four males and three females in the Museum of Vertebrate Zoology were measured for me by Charles G. Sibley; this material gave the same proportions as that of the Academy. In fact, even in the hand, the sexes appear to be the same size. Watson is correct, however, in stating that the gray of the back and wings of the female is darker (fig. 82). This was brought out by placing side by side three females and two males taken in January and February, but the difference is apparent only when the sexes are directly compared. I was unable to use this character in the field because the birds seldom if ever had their backs to me. Only during actual copulation could I be certain of their sex, except by comparing their actions with those of birds observed by others such as Watson, who had the good fortune to have some other way (such as a missing feather) of telling the birds apart.

Pickwell (1930) has compiled a list of trees used by kites for nesting, in which live oak predominates. Sycamore and maple are also listed. De Groot (1938) reports a nest 75 feet up in a Monterey pine, and Moffitt (MS) gives the distribution of eucalyptus in the marshlands north of San Francisco Bay as a critical factor in the distribution of nesting kites in that area. Pairs No. 2 and 3 nested and hunted in adjacent and similar territories, but nested in different kinds of trees. As the nesting trees of the previous years blew down, pair No. 2 nested in five different willow trees in three years. A short distance away pair No. 3 nested for two years, and probably a third, in the same live oak. It appears that any suitable tree may be used that is adjacent to the required food source.

How a certain nesting locality is originally chosen is not known, but once chosen the birds ordinarily return to it year after year unless interfered with. It can only be assumed, however, that the same individual birds return. I found that when the birds of pair 1 failed to return to their nesting site, no other pair took it over even though the food source was still present. From this I deduce that the birds of pairs 2 and 3 returned to, or within a few yards of, their previous nest trees and that other pairs did not occupy their territories. One pair remained near its nesting site through all the winter of 1939-1940 and nested there the next season. What is believed to be the same pair was seen at intervals around this nesting site in the following two winters. Barlow (1897) records two pairs returning to the same grove of live oaks year after year. Kites have been known to appear suddenly in, or to disappear from, a territory. This, of course, may be due to the state of the food source, or it may be due to the death of the young within the nest. Egg collectors have taken eggs and other eggs have been laid in the territory subsequently. Two times, however, when something happened to young that I watched, the birds failed to return to their territory.

I agree with Watson (*op. cit.*) in believing that the kite pairs for life, as appears to be the case with other diurnal raptors, but this is yet to be proved. I have seen kites in pairs at all seasons despite the apparent weakness of the tie during the fall. When seen together in the winter, they call back and forth, join in the attack of other raptors, as was noted on January 9 and 20, 1940, and dispute over food. This latter action is interesting in that when one bird brings in food the other calls much as at mating time but the food is not shared.

In the pair of birds (No. 2) studied most intensively, copulation began toward the end of February, although either copulation or an attempt at it was seen as early as January 7, 1941. On February 23, 1940, I saw the male attempt to copulate, or appear to, but the female refused. The male made a dive over her and then came back and attempted again, but again she refused. He did this eleven times in 20 minutes but had

no better success. They were so intent on their mating that they ignored two crows perched near by. Finally the male flew off and captured a small animal out of an adjacent field, then flew by the female as if using the food as bait, but she still ignored him. The crows did not, however, and took after him. He did not relinquish his prey but protested so heartily that the female flew to his assistance. Where the food went I never found out, but after pestering the kites for a while the crows moved on. The male resumed his attentions, but as long as I watched he was not successful. Nice (1933, 1939) records something like this in her studies of song sparrows and considered it an "intimidation" performance, calling it "pouncing." By this means the male dominated the female, although the female dominated the male in many more ways. I cannot say that this is the same performance in the kite, although it is similar in many ways. This was the only time the diving act was noted except that occasionally one bird, possibly the male, was seen to swoop over the other during the mating season.

On February 26 copulation definitely took place. The female had been away, and as she perched the male flew over and copulated. Copulation seemed to take place quite often from this time on. From then on the male did the hunting. He would bring in the food and perch, then call much as a domestic rooster only more gutturally, calling the female to him. Apparently they divided the food, although he may have given all of it to her. Once when I hid under the perching tree, the female saw me but the male did not. He perched and called but she refused to come. He gave a rasping note as if in anger, if such a term may be applied, but finally flew away as if responding to the female's frantic calling. At this time, too, the male seems to do most of the fighting with other predators, although the female soon takes it up again. Watson puts the copulation period at about 22 days, which in my birds would have continued up to just about the beginning of incubation. These birds, however, were seen to copulate on April 2, and again an attempt was seen on May 19 of 1940. There was no known second nesting this year.

Little information was obtained on territory. The two pairs (Nos. 2 and 3) most intensively studied nested within 400 yards of each other for three years and only once did I see the male of one pair drive off one of the other pair. Usually the pairs stayed away from each other. Red-tailed, Cooper, and other hawks were fought off fiercely in most instances, but were sometimes ignored. There seems to be considerable variation between pairs in this respect. A pair of crows nested within 50 yards of one of the nests of 1940 and both brought off broods successfully with no fighting being observed. Watson (*op. cit.*) covers the subject of territories, finding that each pair defended an area of about one-half square mile. Several times I saw and followed one of the males half a mile away from the nest on a foraging trip, but I have never seen one farther away than this and they usually hunted closer to the nest. Pickwell's (*op. cit.*) birds were spaced much closer and apparently got along well together. During the winter, territorial lines were still less well defined. The birds wandered a great deal and bothered other predators less within the nesting territory and other kites not at all. Each winter pair No. 2 moved its headquarters about 400 yards to the north of the nesting site, although it was often absent from the vicinity.

The birds of pair No. 2 returned to their nesting site to stay in February. By March 5, 1940, they had settled on a willow as a nesting tree and were circling about it. This was within a few yards of the previous years' site. On March 13, 1940, and on March 10, 1941, the veriest beginnings of their nests were seen. Both sexes worked, bringing dead willow branches that they broke off (whether with bill or feet I could not tell) from neighboring trees, but one bird, which sex is not known, worked harder

than the other. These nests appeared to be roughly completed in seven days, although at no time did the birds appear to be working hard at building. The completed nest is lined with grass. Eggs were not laid in the nest of 1940 until about March 30, or 17 days after beginning the nest. Some authorities describe the nests as flimsy and others as being well built. I found one flimsy nest, apparently that used for a second brood; all others were well built, but they tended to flatten out as the young developed, sometimes spilling them out in a high wind. No nests were ever repaired or used over by pair No. 3, which nested in the same tree for three years. Bent (1937) and Taylor (1887) seem to believe that the nests may be reused, although only Taylor presents any evidence for this. [Since writing the foregoing, I have found pair No. 3 using their nest of a previous year for a second brood.]

The birds of pair 3 were settled considerably earlier in two years, and apparently in a third, than was pair 2. In 1939 they had apparently brought off their second brood before August 11, while the second brood of pair 2 was just hatching. In 1940 their first brood was off by May 14, whereas the first brood of pair 2 did not leave until after June 8. In 1941 the first brood of pair 3 was in the process of leaving the nest on May 17, while the young of pair 2 did not leave until about June 10. It seems, therefore, that pair 3 nested consistently about 24 days ahead of pair 2. Strangely enough, although I looked carefully for pair 3 in 1940, I did not find it until the young were well along. In 1941 I kept closer watch, but still the birds kept so well hidden and they so cleverly concealed their nest that I did not find it until there were three eggs in it. For some reason the birds were able to do their hunting and building without my seeing them. Barlow (1895) found five heavily incubated eggs on March 24, 1895, so his nest must have been started in the latter part of February as was the case with my pair No. 3.

Laying begins soon after the nest is finished. On April 2, 1940, three eggs were found in the nest of pair No. 2, and on April 8 there were four eggs. One egg was pipped on April 30, two were found hatched on May 2, a third on May 4, and the fourth on May 7. The last young had then been hatched two days, judging from its appearance and strength. Thus it appears that eggs are laid on consecutive days and that incubation starts with the first egg, as has been reported for many other raptors. Similar observations on nests of pairs 1 and 3 supported this in that the young were of different sizes: one large, one small, and two intermediate in size. Barlow lists the earliest set known to him as found on March 15, 1890, and the latest on May 17, 1891. Eggs observed by me were a chocolate brown when first laid, but they soon faded out to mottled brown and tan. Bent gives four or five as the usual set, with some of three and one of six. De Groot also records one set of six. The sets I saw varied from three to five, with one second nesting of five, one second nesting of three, and three first sets of four. One nest, undoubtedly a second nesting, was known to contain four young.

As indicated above, the incubation period lasts 30 to 32 days, as nearly as I could determine it. An egg produced by pair 2 on April 3 or 4, hatched on May 5 or 6. Because of press of other work it was not possible to follow other nests carefully enough to determine the incubation period exactly, but none of the observations made seemed inconsistent with a period of 30 to 32 days. Pickwell deduced that the period was 30 days or slightly more.

The hatched eggs give the appearance of having been broken by the parents since they are broken inwardly (see fig. 83). It is possible, however, that this effect may result from the drying and shrinking of the inner membrane. The halves figured were found while fresh; in fact one half of the shell still contained a newly-hatched youngster.

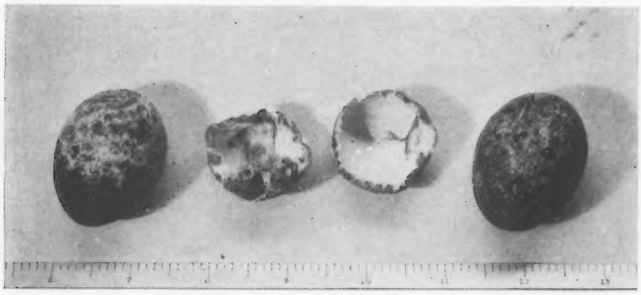

Fig. 83. Eggs of White-tailed Kites, showing manner in which shells are broken open at hatching. The whole eggs are from different pairs of birds.

Infertile eggs seem to be quite common. Of five eggs in one second set, one was known to be infertile and another disappeared soon after the other eggs were hatched. In another second set of three eggs, one was infertile. Both of these were second sets laid following rearing of first broods. When these infertile eggs were blown, they showed no signs of development. Barlow records one case of infertility.

As far as could be determined from pair No. 2, the female does most of the incubating and brooding, while the male perches near by or hunts. Watson also found this to be true. Once when the female left the nest and perched near by for some time, the male flew to the nest and brooded, but the female came in at once and the male left. It appeared that the male was protesting to the female in this way. Both birds came and left by the northeastern side of the nest, even though this might mean turning around to do so. The female would come in and alight on the edge of the nest, look around, and then settle down. The male uttered a note that sounded like *keep* for the first few minutes after arrival near the nest, then continued at about 2-minute intervals after the female went on the nest. She would look this way and that for awhile, then both would quiet down. Both did some preening at such times. The female stayed in the nest exactly four hours at the longest stretch recorded and then left in anticipation of the food that the male failed this time to bring in. In this period she preened and stretched her wings at intervals. This was at a time when she was brooding two newly-hatched young and a third egg that later proved to be infertile.

In the course of an eight-hour period from 8:30 to 4:30, the male went hunting three times. Two of the periods were timed at 16 and 29 minutes each. One expedition was unsuccessful, or possibly the male consumed the prey himself. It seems probable that he may have been out at least once before I arrived to watch and went out once after I left. As the young get older, both parents appear to hunt, but whenever the nest is approached one parent is usually near by. Watson has described the method of food transference from the male to the female and I can but add that this method was used by pairs that I watched. After the transfer the female brings the whole prey back to the nest, stands on the edge and pulls it apart, feeding the smaller portions to the youngsters and eating the larger parts herself. Timed once, this feeding of two very small young took eight minutes. She finished the mouse, taking 10 minutes to tear it apart and devour it. In no instance was the food bolted, as suggested by Miller (1926). Moore and Barr (1941) described interestingly the way in which young learned to tear a mouse apart themselves.

The young at hatching are weak and unable to hold up their heads. The head

appears large in relation to the rest of the body; the eyes are only slits. At this stage they respond to any noise or movement by opening their beaks and peeping weakly. They are covered with a light tan down, with the flesh quite pink beneath. Within a week they are much more vigorous. They hiss somewhat and grasp at twigs when being lifted from the nest. The dark pin-feather sheaths give the birds a bluish cast, and the eyes are a dark brown and are well opened. At two weeks the kites are fairly well feathered on the wings and back. They hiss and scream when bothered.

In three weeks the birds are well feathered throughout. The shoulders are black, the back and breast brown, and the belly white. The eyes are dark brown and the feet yellow. The young react vigorously to handling by opening the beak, grasping with the talons, and screaming loudly. They look much like this when they leave the nest ten days later, except that the brown of the back and breast is then changing to gray and white, respectively. The progress of this change is a matter that will require further study. The eyes do not change from brown to magenta while the bird is still on the nest or immediately thereafter. Just when this change takes place must also be determined by further study.

The young leave the nest gradually. They work out into the branches around the nest and the oldest makes an experimental flight, usually tangling up in branches or blackberries but finally achieving grace. The others follow within a day or two and soon all are able to fly well.

The young apparently return to the nest to feed after they have left it, as the remains of prey were found and the young were seen there, although actual feeding was not seen. They occasionally settled to the ground to rest, an action that was not noticed in adult birds. Four young left the nest of pair 2 on June 8, 1940, and were last seen September 10, when it was noted that the brown breast was almost gone. There was no second nest that year. The young seem to disperse within 45 days and are cared for only for a short time when there is a second nesting. It appears that the first brood may join neighboring broods whose parents are not nesting a second time, since I once found five young kites where there should have been only four. I assume that the young one driven off by its parents joined the other four that were still in the vicinity even though they were much older.

There is some disagreement among observers (Pickwell, Barlow) on the subject of nest protection, but there appear to be differences between pairs which afford grounds for this. Two pairs dived close to an intruder even after the young had left the nest, while one pair made only half-hearted dives at any time. The degree of protection seemed to be correlated with incubation and growth of young, as the old birds' attacks seemed to increase in number and intensity as incubation progressed and reached their height as the young were ready to leave the nest. I was attacked by a pair that was still feeding a brood but had started on a second nest.

Of the number of eggs, which averaged four in five sets, and the number of young hatching, averaging 3.2 in five nests, an average of 1.9 young per nest survived to leave. The total of young raised to this stage by all known pairs (four) in three nesting seasons is 26. Four known pairs produced 15 young in 1939. Two pairs produced 6 young in 1940, and the same pairs produced 5 young in 1941. Thus 1.6 birds per adult have been produced per year. If I had not unknowingly interfered, there probably would have been three more birds to add to the total, and possibly some additional ones.

Deaths of young birds seemed to be due to a number of causes. Several, usually the youngest and smallest, seemed to have been crowded from the nests by the larger young and were found on the ground or hanging from a crotch. One was pushed out

by the female as she flew. Others appeared to fall during high winds after the nest had become flattened. Moore and Barr mention this in relation to the birds they studied. Man was directly responsible for the death of three young. One was found dead in the nest with no cause apparent. Two that disappeared when only a few days old may have been taken by predators, possibly crows. This cause of death may be more serious than previously supposed. One adult bird found along the road appeared to have been hit by a car. Five birds of varying ages were shot by people who thought they were harmful. It is heartening to note that none of the birds banded since 1939 have been reported as shot.

The second nest apparently may be started while the first brood is still in the nest, since the first young of pair 1 left the nest on about May 14, 1939, and the second nest with five eggs that had been incubated from 5 to 7 days was found on June 1. These eggs were hatched by June 25. It is of course possible that the second nest is built much more rapidly than the first. Two certainly known second nests were found, the one mentioned above and one of pair No. 2, found on June 27, 1941. The two young of the latter hatched on July 29 and 30. In 1939, a nest of pair 2 was found on August 11, with the young just hatching. This also was undoubtedly a second nest. Seven young were seen with pair 3 in 1939, so there was possibly a second nesting in this case too. Joseph Dixon tells me that he and his brother found second nests in 1939 and 1941, and Laidlaw Williams says that he has suspected that such occur. Pickwell saw a kite carrying a stick on August 3, 1930, which is late even for a second nest.

After the young leave the nest and disperse, the old birds remain in the vicinity for roughly three months. The young of pair 3 left the nest on May 14, 1940, and May 17, 1941. The adults were not seen as a pair after August 7, 1940, and August 5, 1941. Pair No. 2 behaved similarly, only they were one month later. There is then a period when the birds appear to break up. For instance, in 1940, pair 2 was last seen as a pair, except very rarely, on September 5, and was then seen again more regularly as a pair beginning December 23. The majority of kites seen from August to December appear to be alone, the main exception being the one aforementioned pair seen together all of the fall and winter of 1939. They appear to be still paired, however, and still loosely bound to their nesting site. For, although one can go back time and again to the site and see no birds, other visits will disclose one or both. The kites probably do not stray far since they are seen commonly in the Watsonville area all winter, although somewhat scattered. As mentioned before, pair No. 2 stayed around the nesting site all of the winter of 1939-1940 and much of the winter of 1940-1941. Pair 3 disappeared after nesting and was not seen again until the next nesting season. The birds will be seen more often around the nest site by February and then take up residence. During this winter period each apparently hunts for itself, and when one brings in food the other gutturally "scolds" but has not been seen to obtain food from its presumed mate.

The young birds apparently travel farther and do not return to the place where they were hatched. A bird banded at Corralitos was shot near Salinas, an air-line distance of some 21 miles. Another bird banded at Corralitos was shot near Watsonville, an air-line distance of seven miles. No new nesting sites apparently were taken up in the immediate vicinity of the banding site; therefore it is assumed that the young did not return to nest there.

The White-tailed Kite's method of hunting has been well described by others (Bent, Watson), but authorities disagree on the food itself. Insects, lizards, mice and gophers were apparently surmised by a number of people (Barlow). Fisher (1893) gave *Microtus* as a result of analyzing one stomach, but even later writers (Bailey,

1916; Dawson, 1923) continued to include insects and lizards. Miller gave concrete evidence with his observation of one stomach containing one *Sorex* and four *Microtus*. Pickwell found a *Citellus beecheyi* under the nest and five skulls of *Microtus* in pellets in the nest. Hawbecker adds to this list from three different localities around Watsonville and now adds evidence from 82 pellets. All but one of this latter group contained *Microtus*. One pellet contained three skulls, 12 contained two each, and 68 contained one each. One pellet contained two skulls of *Reithrodontomys*. Many other pellets were examined but records were kept only on the 82. Other pellet analyses now on record (Bond, 1940; Moore and Barr, *op. cit.*) seem to prove that this is the commonest food in all sections. Stoner (1933) records five house mice in one stomach, which may give some clue to an introduced food source. It appears, however, that the White-tailed Kite is nearly as dependent on *Microtus* as a food source as is the Everglade Kite on the snails of the genus *Ampullaria*. The kite's slow, peculiar method of hunting may make it thus dependent. Laidlaw Williams pointed out to me that the last 20 feet of a kite's drop is quite fast, but I believe still not fast enough regularly to catch birds, ground squirrels and rabbits, and other diurnal inhabitants of open ground. The pellets of a Barn Owl (*Tyto alba*) living in the same area were examined and *Microtus* were found present, but many other species, such as *Neurotrichus, Peromyscus, Reithrodontomys,* and birds were also included, indicating that there are other prey species in the area. Thus, it appears that the Barn Owl, being a nocturnal feeder, has a greater variety of prey to choose from, while the kite is limited almost entirely to one diurnal genus.

Recent sight records of the kite seem to show that it is concentrated chiefly around the San Francisco Bay area. This may of course be due to the greater number of trained, interested observers in this area as compared to others, but it is more probably due to the greater amount of a peculiar type of habitat. The farthest south (in California) whence the kite has been reported is near Tia Juana Marsh, San Diego County (Huey, 1931), whereas the farthest north is at Burney Falls, Shasta County (Ingles, 1937). Another northern record is from Miranda on the south fork of the Eel River (Clay, 1926). Records from the Sacramento-San Joaquin Valley are rare. Mowbray (1941) saw one near Colusa. Neff (1932) and Quick (1937) saw birds near Sacramento. Mailliard (1924) saw kites near Modesto, and Hudson (1920) saw them along the Tule River near Porterville. An interesting record is that of van Rossem (1932), who saw a kite along the Mohave River below Victorville. As he states, this is outside the normal range but the necessary willows and marsh are present. My observations show that kites are seen only in a type of habitat that supports *Microtus*. Plotting all of the available recent records on a map, I find that the recorded range (in California) of the kite coincides roughly with large and small river valleys or the vicinities of bays where there is a great deal of grassy land that can support a large population of meadow mice. In general, the kite seems associated with fairly marshy, willow-covered country at low elevations.

Pickwell and others record what might be called exceptions to this, as I did in my pair No. 1. In the case of my birds there was on the adjacent hillside an abandoned apple orchard that had grown up rank with grass. In this grass were innumerable meadow mouse runways and the foraging was carried on over this hillside even where the grass was quite tall. Pickwell's situation was probably similar. It seems probable that kites nest where food is sufficient, and of late years hillsides have so generally been overgrazed that there is no longer much suitable habitat in these areas; therefore the kites must do their hunting in marshy, non-agricultural areas. One can see a good

example of this in the lands of the East Bay Municipal Utilities District near Berkeley, California. There are overgrazed and undergrazed hillsides side by side, and the former are devoid of grass and mice while the latter support both. The interior valley, according to Cooper (1870), once supported a greater population of kites, but since the most moist valley bottoms are cultivated and the hot dry hillsides are overgrazed, there is no place for meadow mice to breed in numbers. This probably accounts for the few recent records of kites in the Great Valley, as it appears to be good "kite country" otherwise.

In 1936 Moffitt (MS) saw 13 kites perched together in a tule thicket in the marsh area north of San Francisco Bay; therefore kites are probably still numerous where conditions are favorable. In some situations, such as where land has been cleared and allowed to become grassy, as in southern Santa Cruz County, or where alfalfa and pasture have been planted on a large scale, the kite may even increase. Quick (1937) records an instance where kites have been seen for 10 years in small oaks in open alfalfa. Peyton (1939) reports an apparent increase in kites in Ventura County, where the birds were seen over alfalfa fields.

The nesting sites of pairs No. 2 and 3 may be in danger due to the gradual dying out of trees along the marsh where they nest and the possible cultivation of their hunting ground. Thus it appears that possibly agriculture is more responsible for an increase or decrease in kites than increased or decreased shooting. Pickwell (1932) reported, however, that most of the kites he had observed two years before were gone, presumably having been shot.

The question naturally arises as to whether kites are scarce and are getting scarcer, or whether possibly there never was a large population within the range. Taylor (1887) believed that the kite was becoming rarer, and the general tone of all kite articles of that time was that of pessimism regarding the kite's survival. McGregor (1901) gives it the status of rare in Santa Cruz County, mentioning only one pair, whereas now there are at least five pairs in the Watsonville district. Moffitt (MS) does not believe that the pairs noted for many years in the salt marshes north of San Francisco Bay have become depleted. It may be assumed, I believe, that where within its range the kite has come in contact with some factor such as agriculture, it may have either increased or decreased. Up to now it appears to have decreased more than it has increased, but it appears to be holding its own or slightly increasing in favorable localities.

As is the custom at the conclusion of an article on a rare species, I herewith give my ideas on methods of conservation for this bird. The kites' nests that I have seen and those of which I have heard are situated on farms. If some organization, such as the one that issued posters lately, would make a contract with each farmer, giving him fifteen dollars a year for each year the birds nested successfully on his farm, he would very probably keep close watch over the birds. Then there are natural refuges, such as the East Bay Municipal Utilities District, where hunting is forbidden and where there are fine nesting sites where the kite could possibly be reintroduced. Education is the "first line of defense" but action is a close second. We may mourn the passing of our rare birds in our society meetings, but until we do something about it actively, we are not helping much.

I would like to acknowledge the assistance of George W. Gosline, Area Conservationist of the Soil Conservation Service, who arranged my time so that field work on the kites could be carried on. Dr. R. M. Bond of the Soil Conservation Service and James Moffitt of the California Academy of Sciences also assisted in gathering data and by reading the manuscript.

LITERATURE CITED

Barlow, C.
1895. In the haunts of the white-tailed kite. Oologist, 12:97-101.
1897. Some notes on the nesting habits of the white-tailed kite. Auk, 14:14-21.
Bent, A. C.
1937. Life histories of North American birds of prey. Part I. U. S. Nat. Mus. Bull., 167:54-63.
Bond, R. M.
1940. Food habits of the white-tailed kite. Condor, 42:168.
Clay, C. I.
1926. Unusual visitors in Humboldt County, California. Condor, 28:98.
Cooper, J. G.
1870. Ornithology. Vol. I. Land birds (Geol. Surv. Calif.):488.
Dawson, W. L.
1924. The birds of California. Book-lovers' Edition (South Moulton Co., San Diego, etc.), 4:1648-1651.
De Groot, D.
1928. Record sets of eggs of California raptores. Condor, 30:360-361.
Fisher, A. K.
1893. The hawks and owls of the United States in their relation to agriculture. U. S. Dept. Agri., Div. Ornith. Mamm., Bull. No. 3:23.
Hawbecker, A. C.
1940. The nesting of the white-tailed kite in southern Santa Cruz County, California. Condor, 42:106-111.
Hudson, L. W.
1920. An albino brown towhee. Condor, 22:80.
Huey, L.
1931. Notes on two birds from San Diego County, California. Auk, 48:620-621.
Ingles, L. G.
1937. Occurrence of the white-tailed kite in northern California. Condor, 39:222.
Mailliard, J.
1924. Autobiography of Joseph Mailliard. Condor, 26:10-29.
McGregor, R. C.
1901. A list of the land birds of Santa Cruz County, California. Pac. Coast Avif. No. 2:6.
Miller, L.
1926. The food of a white-tailed kite. Condor, 28:172-173.
Moore, R. T., and Barr, A.
1941. Habits of the white-tailed kite. Auk, 58:453-462.
Mowbray, V.
1941. In minutes of the Cooper Club, Northern Division. Condor, 43:208.
Neff, J.
1932. White-tailed kites near Sacramento. Condor, 34:259.
Nice, M. M.
1933. Relations between the sexes in song sparrows. Wilson Bull., 45:51-59.
1939. The watcher at the nest (The MacMillan Co., New York):9.
Peyton, S. B.
1939. In minutes of the Cooper Club, Southern Division. Condor, 41:224.
Pickwell, G.
1930. The white-tailed kite. Condor, 32:221-239.
1932. Requiem for the white-tailed kites of Santa Clara Valley. Condor, 34:44-45.
Quick, A.
1937. White-tailed kites observed in Yolo County, California. Condor, 39:132.
Stoner, E.
1933. The white-tailed kite at Benicia, California. Condor, 35:121.
Taylor, H. R.
1887. Nesting of the white-tailed kite. Orn. and Ool., 12:135.
Van Rossem, A. J.
1923. The white-tailed kite on the Mohave Desert. Condor, 25:140.
Watson, F. G.
1940. A behavior study of the white-tailed kite. Condor, 42:295-304.

Soil Conservation Service, Watsonville, California, March 28, 1942.

THE NORTHERN RACES OF PIRANGA FLAVA

By GEORGE MIKSCH SUTTON and ALLAN R. PHILLIPS

For the past five years the senior author has been unable to identify satisfactorily the specimens of *Piranga flava* that he and his collaborators have collected in Nuevo León, Hidalgo, and Veracruz. The junior author, in working out the characters of these tanagers in Arizona also has encountered difficulties. These seem to center (1) in seasonal color variation in adult birds, (2) in great individual variation, (3) in post-mortem plumage changes, and (4) in mixed winter populations.

Seasonal changes from wearing away of feather tips and fading must come about rapidly, especially in arid regions were sunlight is intense. The olive tones, in particular, are fugitive. In a series of six males from Guerrero (all believed to represent the race that breeds there), three October birds from Taxco resemble *P. f. dextra* in color, whereas three summer birds (from mountains near Chilpancingo and Omilteme) are like *P. f. hepatica!*

Individual variation is great, not only in size but also, in males, in intensity of red, presence and extent of yellow, and width of gray tips of back feathers; and, in females, in general color-tone (some birds being dark, others unaccountably pale) and in presence and extent of red. Adult males (at least a year old) often are partly green and yellow, and sometimes wear a complete "female" plumage. A good example of purely individual variation is to be seen in a subadult male from La Joya, Veracruz (virtually a topotype of *dextra*), which is like *hepatica* in color, yet is the smallest (wing 94.5 mm.) in the entire series of 49 red males at hand.

Museum specimens lose some color even though they are well cared for. This is especially true of females and female-type males in which the green tones fade.

Piranga flava leaves the United States in winter as a rule. Winter collections made in Mexico should, therefore, include some of these birds from the United States. But at what latitude does the species cease to be migratory, and how far south do United States birds go? Winter populations in some parts of Mexico obviously are mixed, and identification on purely geographical grounds probably has led to confusion.

With a total of 95 skins before them (most of these lent by the Museum of Comparative Zoology at Harvard, the Dickey Collections of the University of California at Los Angeles, the University of Arizona, the Museum of Zoology at the University of Michigan, the Fish and Wildlife Service, the U. S. National Museum, and Mr. Gale Monson), the authors have focused their attention upon *P. f. oreophasma* Oberholser of Texas and *P. f. zimmeri* van Rossem of Arizona, in the hope of finding winter or transient examples of these races in Mexico and of ascertaining the area in which the two forms intergrade.

Careful study of this series indicates that it is impossible to identify *"oreophasma"* and *"zimmeri"* save on the basis of geographical probability; in other words, unless a given specimen is from Brewster County, Texas, or from Arizona, it is placeable only as a more or less red-backed eastern bird or as a more or less gray-backed western bird. Although birds from Brewster County, Texas, are distinguishable from Arizona birds, the former are indistinguishable from birds of eastern Mexico, the latter from birds of western Mexico.

Only 71 of the 95 above-mentioned specimens are at all suitable for color comparison. These 71 fall readily into two groups, however. Adult males from Arizona, Hidalgo, Morelos, and other western Mexican localities north of Guerrero are more orange-red

below than those from Tamaulipas, Nuevo León, Veracruz and other southeastern Mexican localities, and their backs are duller and their crowns paler; the females are duller, with the sides and wing- and tail-edgings more grayish (less yellowish) green and the throat purer (less orange) yellow. In recently collected females and subadult (?) males the crown is greenish in both series; but in eastern birds this green apparently fades to yellow, especially anteriorly, while in western birds the resultant hue is strongly grayish.

Eastern birds, in the light of the present study, may be known as *P. f. dextra* Bangs (Proc. Biol. Soc. Wash., 20, 1907:30), western ones as *P. f. hepatica* Swainson (see van Rossem, Auk, 59, 1942:88).

It was doubtless Oberholser's inclusion of Arizona birds in his *"oreophasma"* that led Zimmer (Field Mus. Zool. Ser., 17, 1929:213–219) to place the latter in the synonymy of *hepatica* without even examining Texas or New Mexican birds. Careful comparison shows Chisos Mountains birds to be similar in color to Tamaulipas and Nuevo León specimens at hand, and *oreophasma* Oberholser (Auk, 36, 1919:74) must therefore be synonymized with *dextra,* unless it be recognized solely on the basis of slightly larger size.

As for specimens of *"oreophasma"* other than the topotypes, most Texas birds Guadalupe and Davis mountains, etc.) at hand are in such poor condition as to be unsuitable for color comparison. An adult male taken 4 miles northwest of Chloride, Sierra County, New Mexico, on May 21, 1920 (kindly forwarded by Mr. van Rossem), proves to our surprise to be *dextra.* Specimens from the Chiricahua Mountains, Arizona, though mostly in poor plumage, are fairly average *hepatica.*

Previous revisers have considered the range of *hepatica* to include Guerrero and western Oaxaca. Six males and six females from Guerrero are close to *dextra,* however, although the males are a trifle pale, and one of the females (U.S.N.M. 143644, Biol. Survey Coll., from the mountains near Chilpancingo, December 24, 1894) is, if correctly sexed, ultratypical of that race. As for two Oaxacan birds at hand (marked *"hepatica"* by Oberholser) one, a male from Reyes, taken October 19, 1894, is decidedly off color, being the most orange in the entire series; the other (sex?), in postjuvenal molt, from La Parada, August 19, 1894, is closer to *dextra* than to *hepatica* save in crown color, and the nuchal part of the head has not yet attained its first winter plumage.

As for the recently proposed *"zimmeri,"* the authors are fortunate in having before them the only known wintering *P. flava* from the United States, a pair from Patagonia, Santa Cruz County, Arizona, taken March 9, 1940 (Monson and Phillips, Condor, 43, 1941:111), as well as three September females and one April male from Arizona. These are no paler than strictly comparable *hepatica.* The Patagonia male is a little worn, strikingly gray-backed bird that stands out, by reason of this character, from the entire Arizona series; but, contradictorily enough, its crown and throat are the *darkest* red in the entire series of *hepatica.*

Some topotypical *"oreophasma"* are grayer-backed and grayer-cheeked than most *dextra* seen in collections. But the authors are now convinced that much taxonomic work in this group has been done on material that is not comparable; that really fresh, unworn *"zimmeri"* and *"oreophasma"* in *fall* plumage are almost unknown; that breeding *"zimmeri"* and *"oreophasma"* vary hopelessly because of wearing and fading, and are therefore to be used with extreme caution; and that the only sensible solution to the problem of identifying Mexican winter and transient birds is to lump the four forms into two, an eastern and a western, namely *dextra* and *hepatica.*

In size, birds from the United States average larger than those of southern Mexico, as has been repeatedly pointed out; but variation is so great as to prevent recognition of satisfactory races on this basis alone. It is noteworthy that the wing of a female in postjuvenal molt (U.S.N.M. 143641, Biol. Survey Coll.) taken at Tonala, Chiapas, August 16, 1895, measures 98 mm. This bird surely could not have been a transient "*oreophasma*," and its wing length clearly indicates that small size is not diagnostic of *dextra*.

Average and extreme wing lengths in millimeters

	Red Males		
18	*hepatica* from Arizona	(102.0)	97.5-106
5	*hepatica* from Morelos (Jan., Feb.), Hidalgo (Mar.), and Nayarit (June)	(99.0)	97.3-102
1	*dextra* from New Mexico	100	
6	*dextra* from Texas (*fide* Van Tyne and Sutton, Misc. Publ. Mus. Zool. Univ. Mich., 37, 1937:96)	(103.5)	100.5-105.5
9	*dextra* from Tamaulipas (Sept., Oct., Jan., Mar.) and Nuevo León (Feb., Mar., May 1)	(99.8)	96-103
	Type of *dextra* from Jalapa, Veracruz (*fide* Bangs)	96	
1	*dextra* from Oaxaca (Sept. 12)	99.5	
	Females		
8	*hepatica* from Arizona	(98.1)	96-101
3	*hepatica* from Puebla (Jan.), Hidalgo (Apr.), and Nayarit (June)	(95.7)	93.3-97.7
3	*dextra* from Texas (Davis Mts. and Brewster Co.)	(100.5)	100-101.5
8	*dextra* from Tamaulipas (Sept., Oct., March) and Nuevo León (Mar., May 1)	(95.7)	91.5-99
4	*dextra* from Puebla (Jan.) and Veracruz (Apr.)	(93.6)	91-96
3	*dextra* from Chiapas (Jan., Aug. 16) and Guatemala (May 6)	(94.5)	92.5-98

SUMMARY

Piranga flava is represented by two races in Mexico and the United States. The southern eastern race, *dextra*, ranges from Guatemala (at least in winter) north to Oaxaca and Guerrero and along the Sierra Madre Oriental and the mountains farther north and west at least to Chloride, New Mexico. The northwestern race, *hepatica*, ranges from central northern Arizona (east in southern Arizona at least as far as the Chiricahua Mountains) south to the Jacala region of Hidalgo, and Morelos. Northern birds average larger than southern birds, but recognition of additional races, based only on slight size differences, is not warranted in view of the fact that some southern birds are notably large and vice versa.

Cornell University, Ithaca, New York, June 20, 1942.

FROM FIELD AND STUDY

The Aerial Capture of a White-throated Swift by a Pair of Falcons.—On June 10, 1942, while camping at Horse Tank, a permanent desert watering tank within the boundaries of the Kofa National Game Range in the Castle Dome Mountains, about 50 miles northeast of Yuma, Arizona, I had occasion to witness a contest between two masters of flight—a large falcon and a White-throated Swift (*Aëronautes saxatalis*). [On the basis of color, the falcons were identified as Duck Hawks (*Falco peregrinus*), but since no specimen was obtained, the writer feels that a positive record of this species should not be claimed.]

When first sighted at about 100 feet above the tank, the hawk was pursuing the swift. The falcon was about ten feet behind the smaller bird and both were apparently straining every muscle in an effort to gain more speed. As though in an attempt to discourage its pursuer, the swift made an almost perpendicular dive. Although the falcon followed the smaller bird down almost to the ground, it could not seem to shorten the distance between itself and its prospective prey. At about ten feet from the ground the swift pulled out of the dive and strove to gain altitude. The falcon followed closely behind it. Judging from this performance, I assumed that the race would be a fair one. However, just as the swift was regaining altitude, another, smaller falcon of the same species came into view a little above and behind the two birds I had been watching. This smaller falcon, probably the male of the pair, swooped down upon the swift from behind, but a slight change in course by the swift caused the hawk to miss its mark. The larger falcon, presumably the female, continued its dogged chase close to the tail of the swift while the smaller falcon circled and gained altitude. After several moments, the smaller hawk again dove at the swift. This time it hit its mark squarely. When last seen, the pair of hawks was flying off into the distance. The smaller hawk was carrying the swift in its talons.

It will always remain a question in my mind whether or not the larger hawk could have mastered the situation without the coöperation of its apparent mate. Of particular interest was the fact that the two falcons chose to capture a bird as small and agile as a White-throated Swift within a few feet of a desert tank which at that time was frequented daily by several hundred White-winged Doves (*Melopelia asiatica*), Mourning Doves (*Zenaidura macroura*), and Gambel Quail (*Lophortyx gambelii*).—Lee W. Arnold, *Arizona Game and Fish Commission, Phoenix, Arizona, August 4, 1942.*

Southern Record Station for the California Pine Grosbeak.—On July 25, 1942, at a point ¼ mile above the junction of Evolution Creek with the South Fork of the San Joaquin River at an elevation of about 8900 feet, in Fresno County, California, I watched a pair of California Pine Grosbeaks (*Pinicola enucleator californica*) feeding on the ripening fruit of a twinberry bush. These birds were watched for a period of 15 minutes in good light with 8-power binoculars, at distances of 20 to 30 feet. The male was in full red breeding plumage and from various actions I felt sure that the birds were breeding. This is the southernmost location at which I have observed this species in the Sierra Nevada.—Joseph S. Dixon, *Berkeley, California, August 15, 1942.*

Relationships of the Hawaiian Avifauna.—In a recent paper on the limits of the Polynesian Subregion, Mayr (Proc. Sixth Pacific Sci. Cong., 4, 1940: 191-195) excludes Hawaii from Polynesia because in agreement with most other ornithologists he believes that the great majority of the endemic land birds of Hawaii is of Holarctic, usually Nearctic, or of Neotropical derivation. The only Polynesian elements in the avifauna of these islands are two "superspecies" of the Meliphagidae (*Moho, Chaetoptila*), one species of the Muscicapidae (*Chasiempis*) and perhaps two species of extinct or nearly extinct rails. In a paper in the same volume (pp. 185-189) Bryan in an article on Hawaiian birds reaches the opposite conclusion (p. 188) that "the relationship of most of the . . . endemic land birds is with species to the southwest," that is, Polynesian species. He lists several species in addition to those mentioned above which he considers to be of Polynesian origin, but in every case the evidence for considering them to be of American or Palearctic derivation seems to be far more convincing and in some instances conclusive. An example of this is Bryan's treatment of the Hawaiian thrushes of the genus *Phaeornis*. He states (p. 188) that, "they seem to be most closely related to Pacific species of the genus *Turdus*" (*Turdus poliocephalus* and subspecies). As long ago as 1889 Stejneger (Proc. U. S. Nat. Mus., 12: 383-384) carefully investigated the relationships of *Phaeornis* and concluded that it is closely allied to the American solitaires of the genus *Myadestes*. After noting the many striking similarities of structure and color pattern to be seen in both adults and immatures of representatives of the two genera, he wrote: "In fact, were it not for the different proportions of wing, tail, and legs the two birds could hardly be separated generically." Before I knew of this paper, I had reached the same conclusion after comparing *Phaeornis*

with the various genera of American, eastern Asiatic and Polynesian thrushes. While I agree with Stejneger that the two groups are now sufficiently distinct to make it preferable to keep them in separate genera, there would seem to be little doubt that he also was correct in concluding that *Phaeornis* is a derivative of *Myadestes* stock. Neither genus is closely related to *Turdus*.—DEAN AMADON, *American Museum of Natural History, New York, September 7, 1942.*

Bathing of Young Wren-tit by Parent.—On the afternoon of August 31, 1942, three Wren-tits (*Chamaea fasciata*) came to a feeding tray situated at the edge of some chaparral near Cragmont Rock in Berkeley, California. One of the three appeared to be a young bird, the other two adults, probably parents. The former was indistinguishable from the latter, except for behavior, from the point of observation some twenty feet away. The young bird, begging for food by voice and fluttering wings, was fed bread crumbs from the tray by both parents.

After a few minutes one of the adults left the tray; the other hopped into the drinking dish. Following several quick dips under the water the parent returned to the side of the young. By shaking its plumage vigorously the parent spattered water on the young which responded by similarly shaking its feathers. Then by short anteroposterior stroking movements the parent worked its breast over the sides and then neck and dorsum of the young. During this act of grooming the young remained quiet and in a squatting position.

Although Erickson (Univ. Calif. Publ. Zool., 42, 1938:308) states that "not infrequently members of a pair or family preen one another," apparently the behavior pattern described above has not been recorded heretofore.—RICHARD M. EAKIN, *Department of Zoology, University of California, Berkeley, September 15, 1942.*

The Summer Food of Burrowing Owls in Costilla County, Colorado.—Pellets of Burrowing Owls (*Speotyto cunicularia*) collected from July 20 to August 21, 1941, near Blanca in the San Luis Valley, Costilla County, Colorado, give a good indication of the birds' summer food habits. The pellets collected at this time represented the food eaten by young and adults for the last few days that the young remained at the nest burrow and for about a month after the young had dispersed to burrows of their own. Abandoned burrows of prairie dogs (*Cynomys g. gunnisoni*) were occupied in all instances.

At the time the collection was started some of the older pellets about the nest burrows had been somewhat disintegrated by the frequent summer rains so that the exact number of pellets involved in this study could not be absolutely determined. However, as nearly as could be estimated the material collected represented about 81 pellets.

In the following table the presence of food items in the pellets is indicated by per cent of frequency of their occurrence.

As has been noted by Neff (Condor, 43, 1941: 197-198) and Sperry (Wilson Bull., 53, 1941: 45), these pellets indicate that Burrowing Owls usually are opportunists, taking most frequently the kind of food most readily available. On the other hand, Hamilton (Condor, 43, 1941:74) observed them traveling over a mile to bring crayfish to their young when an abundance of other food was available much closer to their nest burrows.

It was of interest to note that those pellets collected about the nest holes where the parents had brought food to the young contained a greater variety of food items than those collected later in the season representing food captured by individuals. Only in three instances when the small pocket mice, *Perognathus flavus*, were taken were the complete remains of a single mammal found in one pellet. Animals the size of a deer mouse or larger appeared to be more than a stomach full for an owl. However, Dr. A. A. Allen of the Department of Ornithology of Cornell University has reported to me that a captive Florida Burrowing Owl which he kept frequently regurgitated more than one pellet from a single meal, depending upon the amount of undigestible material it contained.

Certain of the food items listed in the table were probably accidental. The ants possibly were eaten as they clung to some other bit of food that the owl was devouring. Likewise most of the pellets contained considerable foreign material such as seeds, burrs, and other fragments of plant matter, as well as pebbles and sand. These in all probability were taken in when they adhered to the carcasses the owls tore apart on the ground.

While this method of studying the food habits of burrowing owls gives an approximation of their food habits, it should be remembered that only those food items which contain hard parts resistant to digestion will appear in the pellets.

I wish to express appreciation to Dr. Woodrow Middlekauf, formerly of the Department of Entomology of Cornell University, for his aid in identifying a number of the insects.

Percentage occurrence of food items found in 81 pellets of the Burrowing Owl:

Arthropoda	
Arachnida	1.2
Insecta	
Orthoptera	
Locustidae	40.8
Hymenoptera	
Formicidae	2.4
Mutillidae	1.2
Hemiptera	
Scutelleridae	1.2
Lepidoptera	1.2
Coleoptera	
Curculionidae	3.6
Dermestidae	2.4
Tenebrionidae	
Eleodes	3.6
Embaphion	1.2
Unidentified	10.8
Carabidae	1.2
Scarabaeidae	
Diplotaxis	15.6
Unidentified	3.6
Silphidae	
Necrophorus	31.2
Trogidae	
Trox	1.2
Staphylinidae	1.2
Chordata	
Aves	
Otocoris alpestris	2.4
Passerculus sandwichensis	1.2
Mammalia	
Sorex obscurus	1.2
Citellus tridecemlineatus	1.2
Thomomys talpoides	2.4
Dipodomys ordii	27.6
Perognathus flavus	12.0
Microtus pennsylvanicus	2.4
Peromyscus maniculatus	36.0
Onychomys leucogaster	6.0
Reithrodontomys megalotis	2.4

—William M. Longhurst, *Department of Zoology, Cornell University, Ithaca, New York, August 21, 1942.*

American Redstart in Eastern Oregon.—On the morning of August 6, the writer observed a pair of American Redstarts (*Setophaga ruticilla*) feeding fledgling young at La Grande, Union County, Oregon. The family group stayed for an hour in deciduous trees in an area of a quarter of a city block. On two succeeding days they were observed in the same trees, although on the last day the young were foraging for themselves. This is the writer's first record of the Redstart in Eastern Oregon. Gabrielson and Jewett (Birds of Oregon, 1940:517) regard the bird as of only casual occurrence in Eastern Oregon. They quote Emerson's published record of a specimen taken at John Day in 1899 (University of California Collection=Mus. Vert. Zool.). The last specimen they record is Jewett's, taken in 1916 at Minam, Wallowa County. Our La Grande record was from Riverside Park on the Grande Ronde River, at 2700 feet elevation.—Charles W. Quaintance, *Eastern Oregon College of Education, La Grande, Oregon, August 11, 1942.*

An Unusual Concentration of Hummingbirds.—A white-flowered eucalyptus (*Eucalyptus cideroxylon*) in the San Diego Zoological Gardens, San Diego, California, was the scene on August 12 and 13, 1942, of a congregation of approximately one hundred hummingbirds of at least three species. Identifications were made by Laurence M. Huey and Lewis Wayne Walker of the San Diego Natural History Museum and included Black-chinned, Costa and Rufous hummingbirds, and a somewhat larger individual which was probably an Anna and a far more diminutive bird which may possibly have been a Calliope. Evident was a preponderance of Black-chins which outnumbered all other species three to one; next in number were the Rufous and then the Costa of which there were but two definite identifications. By the second morning certain of the hummers had obviously already chosen their territories and attacked all other birds which attempted to enter such areas. The large blossoms which provided the attraction possessed a sweet, viscid nectar, the taste of which was more strong than the typical eucalyptus-oil flavor.—Ken Stott, Jr., *Zoological Gardens, San Diego, California, August 19, 1942.*

Costa Hummingbird at Papago Park, Arizona.—It was with singular interest that I found a male Costa Hummingbird (*Calypte costae*) visiting the Papago Park botanical garden, ten miles from Phoenix, Arizona, on March 4, 1942; prior to this date I had not seen this species there. The feeding preserve which this bird claimed had previously been designated as No. 7 after a male Black-chin (*Archilochus alexandri*) had settled on it the year before. Upon visiting the preserve late in the afternoon of March 4, I found a male Black-chin (apparently the same bird that had

claimed it in 1941) on guard on an electric wire. A few minutes later he left and the male Costa arrived, perching on a twig of a bird-of-paradise shrub.

From March 4 until April 6 I visited the preserve to see if the Costa would settle on the premises of the Black-chin. Not only did he settle there but he drove off the Black-chin, for after March 16 the Costa was in sole possession. Now and then an intruding Black-chin would steal in to feed from the blooming *Aloes*, but would be instantly routed out by the new owner. On March 16 the Costa engaged in aerial display, as though courting. On my next visit, March 28, he displayed even more vigorously, taking successive dives from a height of seventy-five feet. If a female Costa was present, she escaped my observation.

By March 30 the male Costa had acquired five guarding perches—an electric wire, a tall scape of an *Aloe*, a twig of a palo verde, a higher twig on another palo verde, and the tip of an ocotillo—stations from which he maintained continual vigilance of a plot 500 to 1000 square feet in area. Tiring of one perch, he would fly to another, tolerating no intruding hummer save a female Costa that visited to feed from the *Aloes*. There could be no doubt the Costa had taken possession of preserve No. 7.

Of the twelve or thirteen species of hummingbirds frequenting Arizona only the Black-chin is known to breed in this locality (see Swarth, Birds of the Papago Saguaro National Monument and the Neighboring Region, Arizona, Dept. Interior, Nat. Park Service, 1920:55). This locality lies within the northern limits of the Costa's breeding range, as listed in standard handbooks on western birds.

The climate here is typical of the Lower Sonoran Zone in which the Costa breeds. The elevation is 1100 feet, and the vegetation is characteristically Lower Sonoran, with the exception of some exotic plants recently introduced, such as the *Aloe* (a South African succulent), tree tobacco (a shrub, *Nicotiana glauca*, which, since its introduction from Argentina, grows wild in the Southwest), a species of *Pentstemon*—all excellent sources of floral food for hummers. All around the botanical garden proper one finds Lower Sonoran herbs, shrubs, cacti, and microphyllous trees, among the most prominent being ocotillo, cholla and saguaro cacti, and mesquite and palo verde trees. This "desert" island is surrounded by patches of citrus groves, farms, and gardens.

Five hundred yards east of the botanical garden proper runs an irrigation canal, along the banks of which tree tobacco abounds. Its long, tubular blooms hold a copious supply of nectar, which doubtless has attracted the male Black-chins that have established preserves along the banks of the canal. I have located as many as six individual preserves along a mile strip. But not once from 1939 to 1942, during which period I have made systematic observations of this locality, have I seen a Costa.

The conditions described are suitable for the life needs of Costa Hummingbirds and there is no reason why they should not establish breeding grounds here. What remains to be seen is the future territorial behavior of the bird that has settled on preserve No. 7. It would be interesting to see if the areas occupied by Costas and Black-chins will become co-extensive as the populations expand. Or, will Costas compete for possession of the grounds at the expense of Black-chins? Not least important in deciding the final outcome of territorial competition is the food supply available for individuals that attempt to settle in this locality.—FRANK BENE, *Bethlehem, Pennsylvania, July 23, 1942.*

A New Fossil Bird Locality.—Dr. Chester Stock of the California Institute of Technology has kindly given me the privilege of examining and recording a fragment of bird bone which was taken during the excavation of a Pleistocene mammal fauna in the Highland Park district of the city of Los Angeles, California.

The specimen consists of the basal two-thirds of a coracoid which is identified as the California Turkey, *Parapavo californicus* (L. Miller). The excavation was made upon a building site at Avenue 45 and Lincoln Avenue, not far from the Occidental College Campus.

Bison, horse, and mammoth were the characteristic mammals removed. The bird bone was recovered from the matrix of the mammoth skull during preparation of the latter. About fourteen feet of silt and clay covered the fossil-bearing stratum and mineralization of the bird bone seems complete. There is no corrosion or sand chafing of the specimen, the only defect being fracture, and the broken surfaces are sharply edged. Entombment must have been fairly prompt.

The general locality has been known to the writer for over thirty years and prior to its artificial drainage, it was more or less marshy terrain. A perennial spring of good drinking water still flows from it. The remains of large mammals in fairly concentrated occurrence is at least suggestive of a boggy ground in which they had been mired in Pleistocene time. Dr. Stock is of the opinion, tentatively held, that the age is fairly late Pleistocene.

Localities previously recorded that have yielded specimens of the California Turkey are as follows:

(1) Rancho La Brea, asphaltic matrix, type locality, specimens very abundant.
(2) Carpinteria, asphaltic matrix, specimens abundant.
(3) Workman Street (Los Angeles), fluviatile matrix, two bones.
(4) La Habra (California), fluviatile matrix, one specimen.
(5) Cita Canyon (Texas), fluviatile matrix, one bone.

The locality here discussed is known as the York Valley site.

All records except the one from Texas are from the coastal plain of the San Diegan Faunal District. The extensive deposits from the interior of the state, that is, McKittrick and the caverns of the Sierran foothills, have yielded none, although a turkey of uncertain identity occurs in the cavern fauna and a smaller species is recorded from Niles Canyon north of San Jose. Pleistocene and sub-Recent caverns in Nevada, Arizona, and New Mexico are likewise lacking in records of *Parapavo*. The one Texas record is of Pliocene age. A smaller species replaces it in the Pleistocene of northern Mexico just south of the Texas border.

Was the last stand of a declining species made in the San Diegan District of California?—Loye Miller, *University of California, Los Angeles, September 14, 1942.*

Townsend Solitaire Uses Camp Table for Nest Site.—Townsend Solitaires (*Myadestes townsendi*) use a variety of crannies for nesting. Normally these are found on cliffs in or near forests, about stumps, or at the sheltered bases of trees on steep slopes. The construction of elaborate camp ground tables may likewise offer protected niches that are well drained. The accompanying

Fig. 84. Townsend Solitaire on nest built in camp table.

photograph (fig. 84) shows a solitaire's nest built in an open cupboard of a table in a camp ground at Lake Almanor, Plumas County, California. On June 12, 1942, the nest had 3 eggs and one of the birds was incubating.—C. Andresen, *San Rafael, California, July 28, 1942.*

Notes on the Food of the Horned Owl Near Fallon, Nevada.—On February 26, 1942, an adult Horned Owl (*Bubo virginianus*) was seen on a nest near the south bank of the Carson River, 4 miles west of Fallon, Churchill County, Nevada. This nest had been used the previous year by a pair of Swainson Hawks. The nest, situated near the top of a cottonwood tree (*Populus fremonti*), was estimated to be about thirty feet from the ground. I was unable to examine the contents of the nest, for the limbs supporting it were judged to have insufficient strength to support a person's

weight. Frequent visits were made to the area in the nesting period at which time an adult owl was usually seen on the nest and another was often seen perched in a near-by tree.

The principle vegetation in the area is sagebrush (*Artemisia tridentata*) and many scattered cottonwood trees. California Quail (*Lophortyx californica*) were frequently seen near the nest site.

On April 3, 1942, an adult owl was flushed from the nest and one small downy young was seen protruding above the edge of the nest. On other occasions when the adult flew from the nest, due to my presence, it usually returned in about twelve minutes, from a different direction than that taken when it flew from the area. On April 19 the young was not in the nest but it was found on the next visit to the area, April 27, at which time it was seen perched in a small tree about ten feet high. This small tree was about 200 feet east of the nest.

Two adult owls, and the young that was yet unable to fly, were seen repeatedly in the area until May 5, at which time the young was judged to be fully grown. On May 20, the date of my last visit to the nest area, the young was not located but one adult was seen.

Repeated search for pellets in the area resulted in the finding of fifty-five under trees near the nest. None was found under the nest. In consideration of the length of time that the area was under observation, this number of pellets is low compared with the findings of Bond (Condor, 42, 1940: 164-165) in Pahranagat Valley, Nevada. Conceivably this is due to the number of trees in the area that afford numerous places for the owls to perch. This may scatter the pellets over a larger area where they would be more difficult to find.

Only the cranium and lower jaws, or their parts, were saved from the pellets for study. Each part found was recorded as one individual prey item. For example, one cranium and a lower jaw were recorded as two prey items. Results of the pellet examination were as follows:

	Number of items	Percentage of total items
Ground Squirrel (*Citellus townsendi*)	10	31.3
Pocket Gopher (*Thomomys bottae*)	5	15.6
Meadow Mouse (*Microtus montanus*)	3	9.3
Cottontail Rabbit (*Sylvilagus nuttallii*)	12	37.5
California Quail (*Lophortyx californica*)	2	6.3

On April 3 a dead California Quail was seen lying on the edge of the nest. On three occasions, California Quail feathers were found under trees where pellets were picked up. Feathers and wings of a Long-eared Owl (*Asio wilsonianus*) also were picked up from under a tree near the horned owl nest. It is not known whether the three quail or the long-eared owl were captured or eaten by the horned owls. In addition to the mammal and bird remains found in the pellets, the mandible of one Jerusalem cricket (*Stenopelmatus*) was found.—J. R. ALCORN, *U. S. Fish and Wildlife Service, Reno, Nevada, July 12, 1942.*

NOTES AND NEWS

The Sixtieth Annual Meeting of the American Ornithologists' Union was held at the Academy of Natural Sciences in Philadelphia, October 12 to 16, 1942, with a registered attendance of 192. Twenty-seven scientific papers were read—many illustrated by color slides or films. Officers for the new year are: President, James L. Peters; Vice-presidents, George Willett and Hoyes Lloyd; Secretary, Lawrence E. Hicks; Treasurer, J. Fletcher Street; Editor, John T. Zimmer; new members of the Council: Arthur A. Allen, Rudolphe M. De Schauensee, Robert C. Murphy and Rudyerd Boulton. The Brewster Medal Award was made to Margaret M. Nice of Chicago for her publication on the "Life History of the Song Sparrow." Fellows elected were: Clarence Cottam, Rudolphe M. De Schauensee, and Harrison F. Lewis. Members named were: Earle R. Greene, Harry W. Hann, Robert C. Miller, Earle L. Poole, and S. Dillon Ripley. The 1943 meeting, if conditions permit, will be held in New York City, in October.—Lawrence E. Hicks.

Mr. N. B. Kinnear, Secretary of the British Ornithologists' Club, has invited members of the Cooper Club who are serving with the United States or Canadian armies in England to write to him. He will endeavor to put them in touch with local ornithologists and advise them concerning books. Mr. Kinnear's address is the British Museum (Natural History), Cromwell Road, London, S. W. 7.

Publication of the extensive article by Albert Wolfson in this issue of the Condor was made possible by gifts which contributed part of the expense of printing.

The editors of the Condor take occasion to thank several people who have assisted in the work of issuing volume 44 of the magazine. Mr. E. L. Sumner, Sr., has prepared the copy for the index and Hilda W. Grinnell, Janet Failla, Virginia D. Miller, Harvey I. Fisher and Frank A. Pitelka have aided with proof and manuscript. —A.H.M.

COMMUNICATION TO THE EDITOR

In its main outlines, a man's character is sketched early; time but deepens the etching. How "the child is father of the man" is further impressed upon me every time I read the charming biography of Charles Wallace Richmond in Gregory M. Mathews' great work on "The Birds of Australia" (Suppl. No. 4, 1925: iv-viii). Though unsigned, it is clearly identifiable by its whimsical humor as self-written.

From conversations with Richmond, the writer is able to describe one incident and to give details of two others, additional to the account cited and he has long had an urge to do something of the kind as a tribute to a lovable friend.

In his early collecting forays in what is now Rock Creek Park of the District of Columbia, Richmond was harassed by a certain policeman. From time to time the officer halted him but found no contraband. After a good deal of this hide and seek, Richmond was finally caught with the goods—a screech owl—and taken to court. The judge asked, "Don't you know you can't collect birds in the District of Columbia without a permit?" "Yes," replied Charlie, who had never mentioned permit to the officer, "here it is." Thereafter that particular policeman could no longer see him. The way in which this episode developed depended upon Richmond's personality and exemplifies the patiently humorous view of life that he held to the end.

One of the varied employments of Richmond's youth was as a page in Congress. In that period, opportunity threw in his way a quantity of passes to an exhibition in the Patent Office. The number being larger in his estimation than anyone could conceivably use, Charlie distributed a good many of them to acquaintances and the place of the exhibit was soon flooded with children. Investigation brought retribution, but who shall deny but that in the not wholly formed ethic of youth he felt fully justified in doing something for his friends. So regarded, this largess was an early example of an activity—helping others—of which he never wearied.

Many boys then indulged in bird-nesting but this was one boy with whom it was more than a passing fad. Nevertheless, he was surprised when he learned that there were grown men in the Smithsonian Institution who studied birds. Of course, he wanted to know them and he thought he might be better received if he came with a present. So bundling in a paper parcel some of his treasures—nests and eggs—he climbed the spiral stairs to the old dim and dusty Bird Gallery of the Smithsonian. At their head, he gave a shy knock on the first door, which was answered by a hearty, "come in." There sat a sandy-haired man with an impressive mustache that did nothing to decrease Richmond's awe. But the man, Robert Ridgway, saying, "Let's see what you have there sonny," helped to unwrap the package. Richmond was prepared to identify the contents but soon found that this was unnecessary, as Ridgway said, "So you've got a catbird's; and a cuckoo's, they're not so easy to find." On he went, commenting on

every specimen, "And you want to give them to us, that's fine." His reception was so kindly, so beyond anything Richmond expected, that the boy was in ecstasy. In later life he never could think of the visit without the tears coming. His ambition from that moment was to be an ornithologist, to be like Mr. Ridgway.

And he was like him, especially in generosity. He was kind to many others as Ridgway was to him. Despite the best of will, we are often unable to repay our benefactors, but we can in a sense repay by aiding others. With a genius for friendly helpfulness, there can be no doubt that C. W. R. over and over again repaid his debt of kindness.—W. L. McAtee.

PUBLICATIONS REVIEWED

Occasionally there appear well-prepared studies of local distribution of birds. A recent good example is Arthur C. Twomey's survey of "The Birds of the Uinta Basin, Utah" (Annals Carnegie Mus., 28, 1942:341-490, plates XXXIX-XLIX, including 16 photographs and three folding maps). The level of organization and general standards displayed in this paper are particularly heartening; for in the past few years, the attention paid to less explored parts of the North American continent has yielded a series of local lists many of which lack signs of concentrated study and groups of which might better have been published under a single title instead of being scattered through the ornithological literature.

Twomey's field studies were made from April to October in 1937, although specimens and data collected in 1934 and 1935 by A. C. Lloyd in certain parts of the study area were available to him. Considering time limitations and the size of the area (over 10,000 square miles), the author has succeeded in accumulating a surprisingly large amount of material.

Introductory sections discuss itinerary and major collecting localities. Geological and ecological features of the area are described well, and the text is accompanied by excellent maps of surface formations and plant communities. The area ranges in altitude from 4500 to 13,500 feet, and at least six major ecological zones are recognized. For each of these, characteristic birds and plant associates are discussed. Certain successional communities of importance in bird distribution are treated similarly.

The greater part of the paper is devoted to an annotated list of 208 species: of these eight are represented by two races, one by three races; an additional hybrid is also listed. One new race, *Sitta carolinensis uintaensis*, is described. Annotations include notes on systematics, local distribution, dates of occurrence, and natural history. There is a "bibliography of works consulted" including almost 200 titles. Typographic slips are few; only four errors were detected in the body of the paper by this reviewer.

As regards the systematic aspect of the work, Twomey follows the 1931 A.O.U. Check-list "except for such changes and additions that the author believed justifiable." This conditional statement means little when one notes certain inconsistencies of treatment. Thus, some divergences from the A.O.U. Check-list are accompanied by discussions of specimens at hand and by references to bibliographic sources. In other instances, trinomials are used (as in *Sturnella neglecta, Oberholseria chlorura, Euphagus cyanocephalus, Icterus bullocki, Cyanocephalus cyanocephalus*, and others) which indicate an implicit acceptance of recently described races although no evidence is set forth to show why these races are regarded as "justifiable." There are and will be inevitable differences of opinion with respect to a number of races which Twomey lists. Several problems are opened to further study as, for example, the breeding of presumably both *Buteo borealis calurus* and *B. b. fuertesi* in the same area, and the relations of *Dendroica aestiva morcomi* and *D. a. brewsteri* in the Great Basin. If only for the sake of convenience, the author might have referred to sources in every instance when a systematic change or addition subsequent to the A.O.U. Check-list was introduced, since his bibliography lists most of these sources. But the bibliography is not comprehensive. Thus, in the case of *Tyrannus tyrannus*, no reference is made to discussions of the race *hespericola* by Zimmer (Am. Mus. Nov. No. 962, 1937:12) and Wetmore (Proc. U. S. Nat. Mus., 86, 1939:199); under *Vireo gilvus*, no mention is made of Sibley's review of the western races (Condor, 42, 1940:255-258). The footnote on page 439 concerning *Vermivora ruficapilla* is superflous since the point in question is adjusted by the 1931 Check-list.

In most species the use of the trinomial, whatever the decision as to name, is supported by specimens. The races of only two species (pages 367 and 407) are stated to have been "determined on geographic grounds." But trinomials are used in a number of additional species listed only on the basis of either field observation or second-hand reports. No specimens of *Astur atricapillus, Falco columbarius, Progne subis, Corvus corax, Spinus psaltria*, and others, were taken; the use of the trinomial in such instances seems inadvisable. *Glaucidium gnoma pinicola* is listed on the basis of a record which, at best, is hypothetical. *Numenius a. americanus* is listed on the basis of observations of individuals which might have included migrants of *N. a. occidentalis*.

As regards general distribution of species, it is

worthwhile to mention the Mockingbird and Scott Oriole, both of which apparently have extended their ranges northward in Utah. The White-faced Glossy Ibis has appeared in the Uinta Basin with extensive irrigation. There is a well established colony of California Quail, introduced about 1914. It is surpising that no Western Sandpipers were detected in the flocks of Semipalmated Sandpipers reported by the author!

Twomey's report constitutes a valuable contribution to the ornithology of the Great Basin. It is well prepared and the author seems to have obtained the most from his efforts in the field. —FRANK A. PITELKA.

MINUTES OF COOPER CLUB MEETINGS

NORTHERN DIVISION

JULY.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, July 23, 1942, at 8:00 p.m., in Room 2503 Life Sciences Building, University of California, Berkeley, with Dr. Alden H. Miller in the chair and 45 members and guests present. After the minutes of the Northern Division for June had been read and accepted, and the minutes of the Southern Division for May had been read, the following were proposed for membership: Mr. Benjamin H. Banta, Box 605, Reno, Nevada, and Mrs. Naoma Packwood, 100 Spring Street, Susanville, California.

Mr. E. L. Sumner, Sr., reported mockingbirds near Larkspur on July 7. Dr. Miller mentioned the finding of Grasshopper and Savannah sparrows nesting in the Berkeley Hills. Robert W. Storer mentioned finding a dead Fork-tailed Petrel on the beach at San Francisco on July 14.

Resolutions recommending that Harold M. and Josephine R. Michener and George Willett be made Honorary Members of the Cooper Ornithological Club were read.

Dr. Miller then introduced the speaker of the evening, Dr. Ian McTaggart Cowan, Assistant Professor of Zoology at the University of British Columbia, who spoke on "Birds of the Alaska Highway" or "Migrants and Mud." The trip on which this talk was based was made in 1938 to the Peace River Valley about 50 miles east of the Rocky Mountains in British Columbia.

Adjourned.—ROBERT W. STORER, *Acting Secretary.*

SOUTHERN DIVISION

JULY.—The regular monthly meeting of the Southern Division of the Cooper Ornithological Club was held on Tuesday, July 28, 1942, at 8:00 p.m., in Room 145, Allan Hancock Foundation, Los Angeles, with President Sherwin F. Wood in the chair and 48 members and guests present. Minutes of the Southern Division for June, 1942, were read and approved as corrected. Minutes of the Northern Division were read by title only. One new application for membership was read, as follows: Kenneth R. Halstead, 4137 North E Street, San Bernardino, California, proposed by Wilson C. Hanna.

The recommendation for election of Harold M. Michener and Josephine R. Michener, of Pasadena, California, to Honorary Membership in the Cooper Ornithological Club, which had its first reading at the June meeting of this Division, was re-read in accordance with provisions of the Constitution of the Club. Upon motion by Dr. H. R. Painton, seconded by C. V. Duff, the elections were unanimously passed by the Southern Division.

A proposal that George Willett, of Los Angeles, California, be elected an Honorary Member of the Cooper Ornithological Club, in recognition of his extensive service to the science of ornithology in western North America, especially through his studies and reports on the birds of Alaska and southern California, and through the essential part he plays in the organization of the Cooper Ornithological Club and the American Ornithologists' Union, was read. In keeping with provisions of the Constitution, action on this proposal will be taken at the August meetings of the Northern and Southern divisions.

Several interesting recent observations were reported. Ed Harrison told of seeing two Wood Ibises at Encinitas last Sunday. Dr. S. F. Wood made comments on the occurrence of the Water Ouzel in our local mountains. J. C. von Bloeker, Jr., reported that, while on a field trip with Dr. Adele Grant's ornithology class on July 26, a large nesting colony of Purple Martins was observed at the Balboa pavilion and a single Pectoral Sandpiper was seen on the mud flats at the entrance to the Bolsa Chica gun club. C. V. Duff told of a method of starling control, through rendering an area thoroughly unattractive to these obnoxious birds, which had been reported to him. Dr. L. A. Test reported the occurrence of Band-tailed Pigeons in flocks numbering from 10 to 60 individuals in the vicinity of Lindsay, California. He said that, because these birds had been reported to be doing damage to the olive crop, permission had been granted to some of the ranchers to destroy them and numbers of them have already been shot.

President Wood then introduced the speaker of the evening, Mr. Frank G. Watson, of Long Beach, California, who spoke on "The White-tailed Kite, Its Nesting and Behavior." The subject was based on Mr. Watson's personal observation of these birds in the San Joaquin Valley and proved very enlightening, especially to those of us who have observed White-tailed Kites only on rare occasions or not at all.

Adjourned.—JACK C. VON BLOEKER, JR., *Secretary.*

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